United States Department of Agriculture

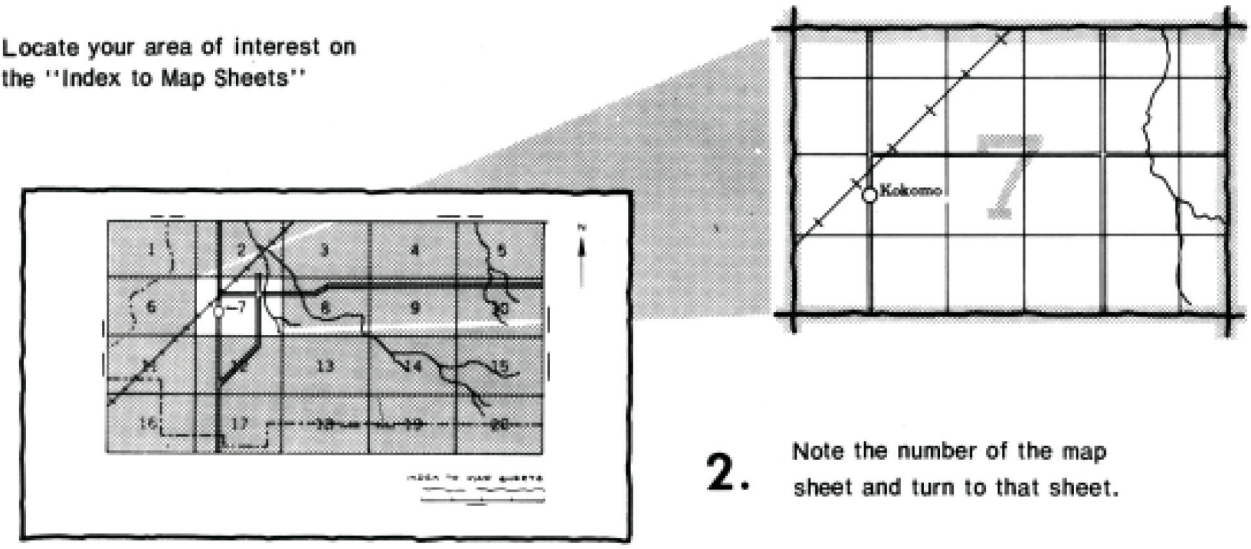
Soil Conservation Service

In Cooperation with Texas Agricultural Experiment Station

Soil Survey of Willacy County Texas

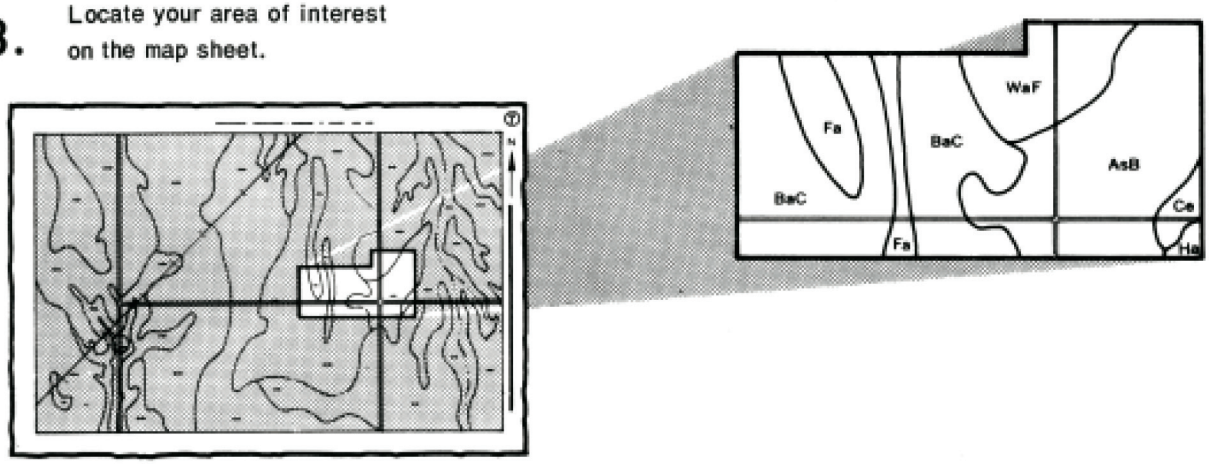
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

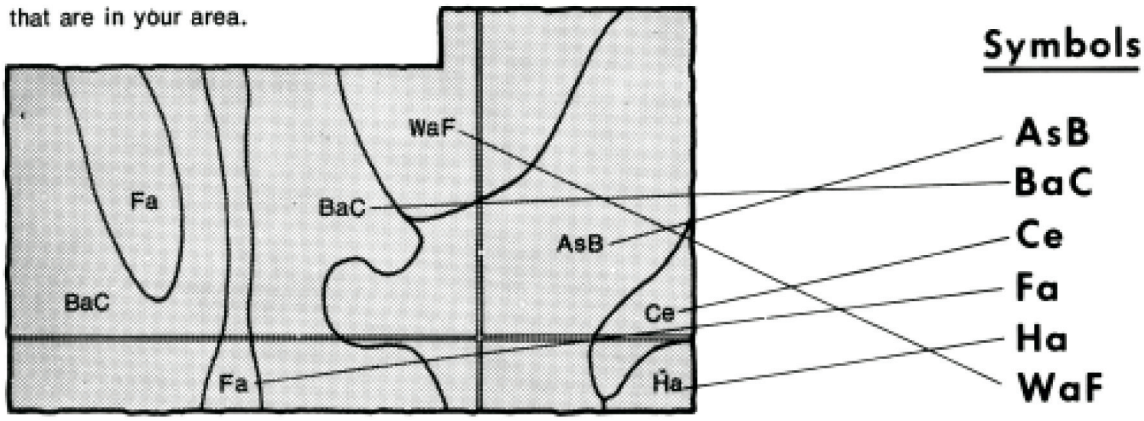


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

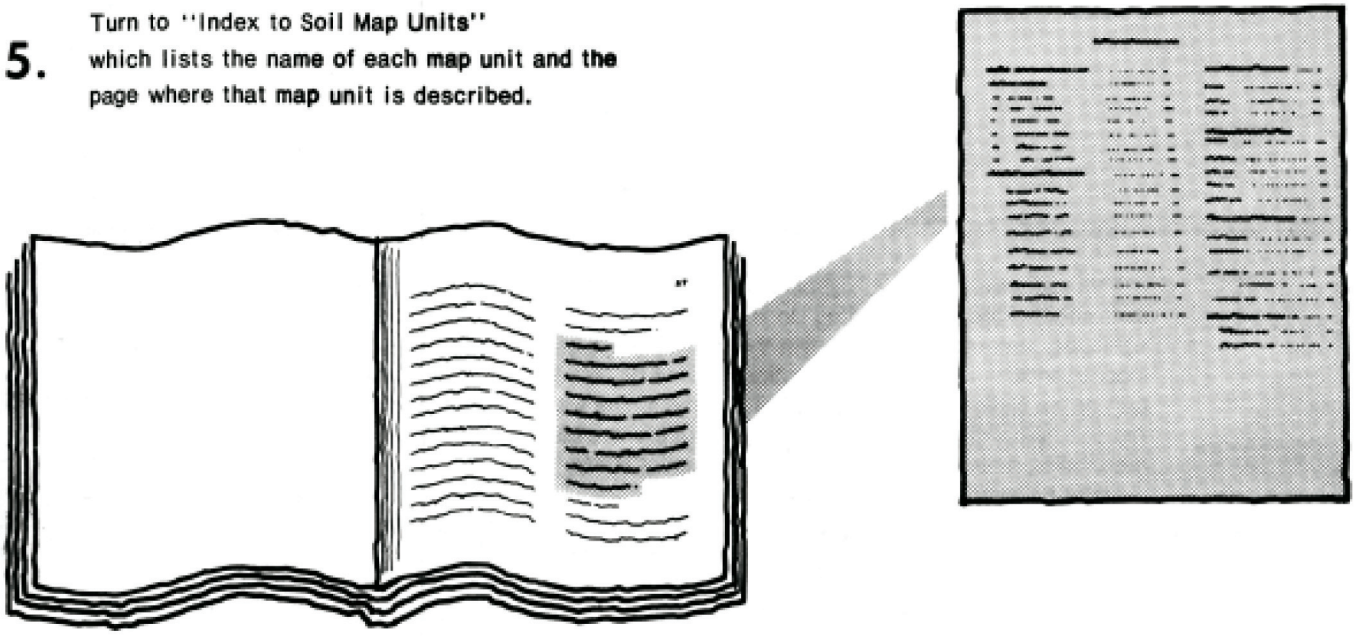


4. List the map unit symbols that are in your area.

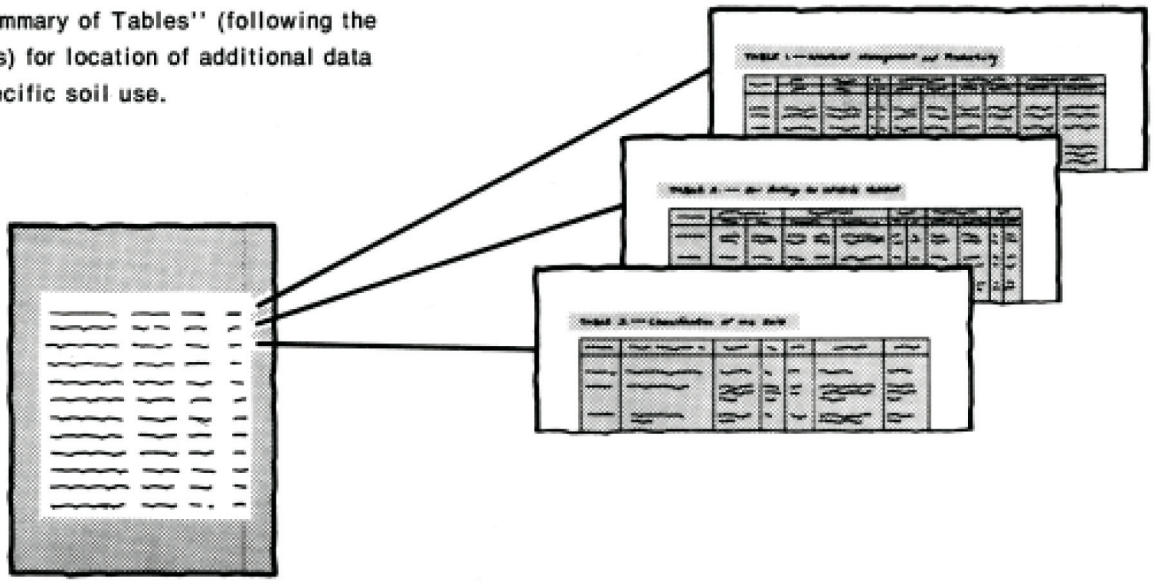


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1973-79. Soil names and descriptions were approved in 1980. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1979. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Willacy Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

This survey supersedes the soil survey of Willacy County published in 1926 (*17*).

Cover: Irrigated cabbage on Raymondville clay loam, which is the dominant soil in the county.

Contents

Soil series

Issued December 1982

Index to map units

Summary of tables

Foreword

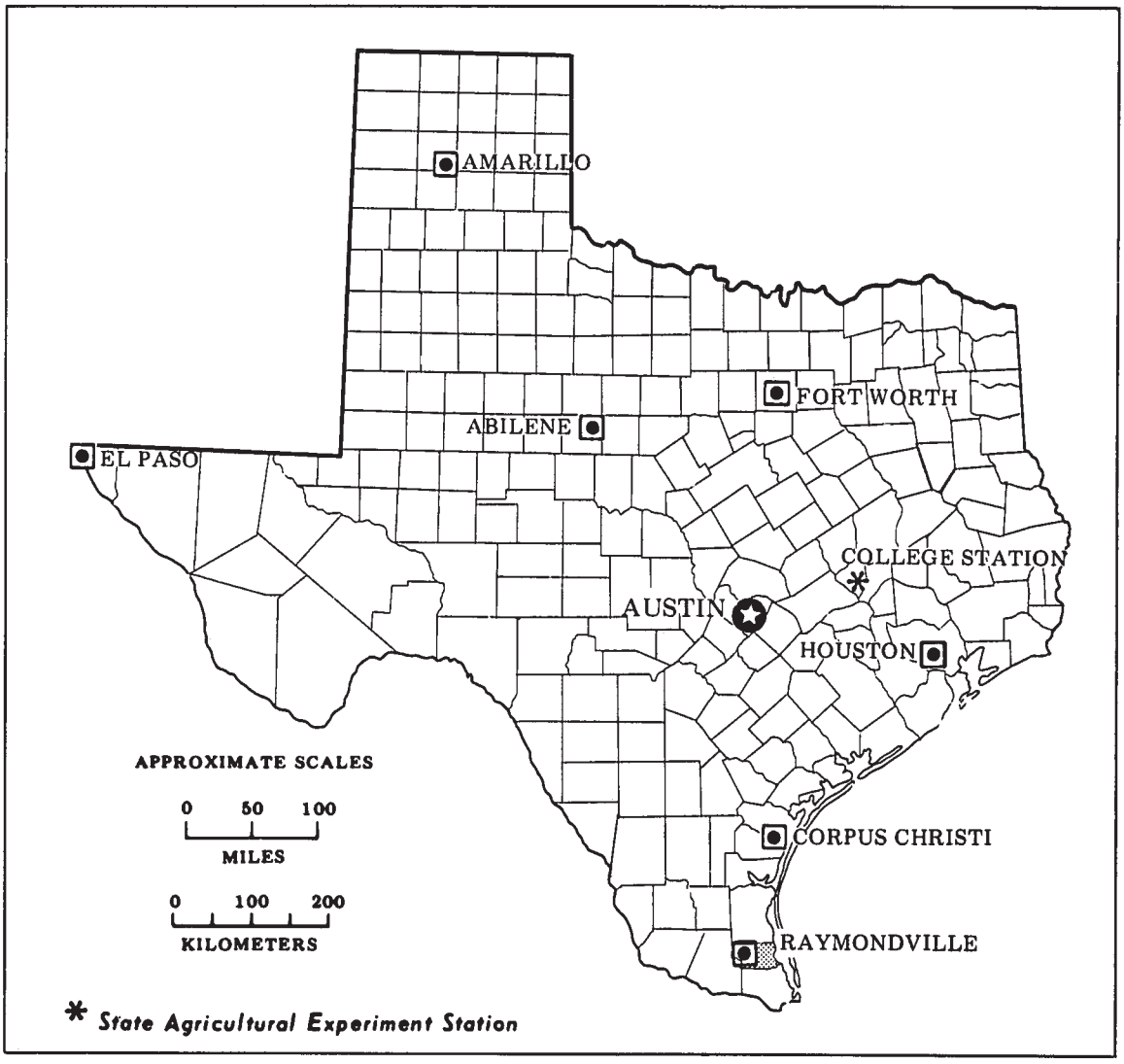
This soil survey contains information that can be used in land-planning programs in Willacy County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

George C. Marks
State Conservationist
Soil Conservation Service



Location of Willacy County in Texas.

Soil survey of Willacy County, Texas

By August J. Turner, Soil Conservation Service

Fieldwork by August J. Turner, Harold H. Hyde, and Jerry L. Jacobs, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Texas Agricultural Experiment Station

WILLACY COUNTY is in the southern part of Texas. It has a total area of 472,320 acres. Of this, 419,840 acres is land area and 52,480 acres is water area. The population of the county is 16,849. Raymondville, the county seat, has a population of 9,009.

Willacy County is in the Central Rio Grande Plain, the Gulf Coast Saline Prairies, and the lower Rio Grande Valley Major Land Resource Areas (*4*). The survey area is in the West Gulf Coastal Plain section (*7*) of the Coastal Plain geomorphic province. There are no natural drainage channels in the county. The surface water from rains moves off in a body into the Laguna Madre. The elevation ranges from sea level at the coast to about 90 feet in the western part.

About 44 percent of the county is cropland, 33 percent is rangeland and pastureland, 11 percent is water areas, and the rest is urban and build-up areas, wildlife habitat, and other land uses.

About 17 percent of the cropland is irrigated. Sugarcane, vegetables, and citrus are the main irrigated crops. Cotton and grain sorghum are the main nonirrigated crops. Raising beef cattle is the main ranching enterprise.

Descriptions and names of soils in this soil survey do not fully agree with those on soil maps for adjacent counties. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of soils within the survey area.

General nature of the survey area

This section provides general information about Willacy County. It discusses the climate, history and development, and agriculture of the county.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

In Willacy County the long summers are hot and humid, but the coast is frequently cooled by sea breezes. Winters are generally warm and are only occasionally interrupted by incursions of cool air from the north. In most years, rains occur throughout the year and precipitation is adequate for most crops. In some years, drought reduces crop yields (*14*). These drought periods are caused by a warm-core high-pressure cell that generally occurs over the Great Plains during the summer months. The intensity and duration of the dry periods are determined by the strength and longevity of the high-pressure cell.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Raymondville, Texas, in the period 1951 to 1978. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 60 degrees F, and the average daily minimum temperature is 49 degrees. The lowest temperature on record, which occurred at Raymondville on January, 13, 1962, is 14 degrees. In summer the average temperature is 84 degrees. The highest recorded temperature, which occurred at Raymondville on August 8, 1953, is 107 degrees.

The average frost-free growing season is 331 days. The first killing frost occurs about December 11th and the last killing frost about February 6th.

Growing degree days are shown in table 3. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average

temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 27 inches. Of this, 19 inches, or 70 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 13 inches. The heaviest 1-day rainfall during the period of record was 9.90 inches at Raymondville on September 1, 1975. Thunderstorms occur on about 25 days each year, and most occur in summer.

Snowfall is rare. The greatest snow depth at any one time during the period of record was a trace.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 90 percent. The sun shines 80 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the southeast. Average windspeed is highest, 14 miles per hour, in spring. In an average year, free water (lake) evaporation is 58 inches.

The largest and most destructive storms affecting Willacy County are tropical cyclones. Those cyclones with sustained windspeeds of 74 miles per hour, or greater, are known as hurricanes and are a threat to the area in late summer or early fall, but major storms are rare. Flooding from torrential rains accompanying these tropical storms is the most likely cause of property damage. Prior to Hurricane Beulah, September 18 through 23, 1967, the last major hurricane to directly strike the county was on September 4 and 5, 1933.

Unless the land is irrigated, the agricultural seasons correspond to climatic periods. The planting season takes place during the months of low to moderate rainfall (February and March); the growing season continues through the rainy months, in April, May, and June. During July and August, when little precipitation is received, crops are harvested. The heavy rains in fall help to prepare the soil for cultivation, and they provide moisture for fall feed crops and for spring crops.

History and development

Willacy County was named for John G. Willacy, a Texas legislator (*16*). It was one of the first areas of Texas to be explored by the Spaniards. The coastal area was mapped by Alonzo Alvarez de Pineda and was crossed by Cabeza De Vaca in his travels.

The area was described by early explorers as a vast sea of grass broken by only a few oak mottes in the northeastern part. The San Juan De Carricitos grant, which included present Willacy County, was made by the Spanish government in 1793 to Jose Narcisso Cavazos.

La Sal Vieja (Old Salt Lake) and El Sal De Rey (Salt of the King) were the most important geographical spots in South Texas for centuries. Indians and early settlers came to the great lakebeds to gather salt for their diets, for tanning skins, and for trading.

Prior to the independence of Texas, this survey area was not settled but was the property of Mexican landowners who lived in places such as Monterrey and Mexico City. After Texas became independent, the area between the Nueces River and the Rio Grande River was a disputed zone for many years.

Both the United States and Mexico claimed this vast area, known as the "Wildhorse Desert." Because neither country had clear jurisdiction, it became a haven for bandits. When it finally became a part of Texas, land was purchased from the original grantees by Captain Richard King and a few other pioneers for the raising of livestock. For the next half century, cattle raising was the sole enterprise from Corpus Christi south to Brownsville.

In 1904, Edward Raymond, a foreman for the King Ranch and owner of the 65,000-acre Las Majadas Ranch, gave the right-of-way to the Rock Island Railroad to extend to Brownsville. This opened the way for farmers and ranchers to colonize the vast prairie. In 1911, Willacy County was created by the division of Cameron and Hidalgo Counties, and 10 years later Kenedy County was created from the northern part of Willacy County.

Agriculture

From about 1910 to 1920, farming and ranching were perilous occupations because of the constant forays by bandits along the border. After the quelling of the bandit problem and the construction of the railroad and of a vehicular road from Corpus Christi south, the area began to thrive. Land was cleared of brush and planted to corn, cotton, and forage crops.

In 1941, the Willacy County Water Control District constructed Delta Lake as a reservoir to irrigate about 35,000 acres in Willacy County. Farmers began to grow citrus, cotton, grain sorghum, and vegetables, especially onions, on the fertile irrigated soil. Onions were shipped by railroad across the nation for many years. When vegetable prices began to decline, farmers of irrigated crops increased their acreages of cotton and grain sorghum. The citrus acreage has remained at approximately 3,000 acres. Most of the productive nonirrigated soils have been cleared of brush and are planted to cotton and grain sorghum.

In the early 1970's, sugarcane was reintroduced to the Lower Rio Grande Valley, and Willacy County had an initial allocation of about 3,500 acres. The acreage in sugarcane increased to about 4,000 acres in 1979.

The county is the only one in the State of Texas that does not have a creek, river, or other natural waterway

through it or on its boundaries. This has created major problems for agriculture because the many manmade structures, such as roads, railroads, irrigation canals, and modern expressways, tend to block runoff and to impound water from frequent heavy rains, resulting in flooding, high water tables, and salinity problems in the soils.

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland managers, engineers, planners, developers and builders, home buyers, and others.

General soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The land area of the 14 general soil map units in Willacy County makes up about 89 percent of the total acreage. The rest is water areas.

Soil descriptions

Loamy and clayey soils dominantly of the middle and high stream terraces

This group of soils makes up about 55 percent of the county. These loamy and clayey soils are on nearly level flats and gently sloping ridges on stream and coastal terraces. The dominant soils are Delfina, Hargill, Hidalgo, Lozano, Lyford, Mercedes, Racombes, Raymondville, and Willacy soils. Most of the soils are in cropland. In a few areas, they are used for improved pasture, citrus orchards, and native range.

The stream terraces are smooth and slope very gently downward to the northeast (fig. 1). Because there are no stream channels within the county, runoff flows slowly through a series of broad flats and faint depressions.

The middle stream terrace and low coastal terrace are rarely flooded. Floodwater enters the southeastern part of the county as a broad, shallow, slow inundation when the Rio Grande River is at very high flood stage. The water contains little or no sediments but has an appreciable concentration of calcium and magnesium carbonates. Some of the water is ponded; then it evaporates, leaving carbonates, which make the soils calcareous. The nonflooded soils are generally noncalcareous.

Other features of this deltaic landscape are loamy ridges, drainageways, and depressions. The loamy ridges are eolian deposits that are 5 to 15 feet above the surrounding areas. The drainageways are associated with these ridges. The depressions formed in abandoned stream channels or along old fault lines, or earth cracks. Some of the depressions may be blowouts from saline areas.

The uplands in the extreme western part of the county are underlain by loamy loess deposits that are older than the delta deposits and generally 5 to 20 feet higher than those deposits.

The ridges northwest of La Sal Vieja, an old salt lake, are 35 feet or more higher than the surrounding area. They are made up of material that has blown out of the basins of these old salt lakes after evaporation of the water.

These soils are covered mainly by grasses, shrubs, and trees, which are common in the county. In most places, the gradual deposition of the material forming the ridges allowed the salts to leach out. In some places, however, the more recently deposited materials are still high in salt content and the vegetation is salt-resistant plants.

1. Raymondville-Mercedes

Nearly level, moderately alkaline, nonsaline loamy and clayey soils

This map unit makes up about 14 percent of the county. It is about 73 percent Raymondville soils, 15 percent Mercedes soils, and 12 percent soils of minor extent, mainly Lozano, Lyford, and Delfina soils.

Typically, the Raymondville soils have a grayish brown clay loam surface layer about 16 inches thick. The subsoil, which extends to a depth of 46 inches, is light brownish gray clay loam. The underlying material to a depth of 60 inches is very pale brown clay loam. These soils are calcareous throughout, moderately well drained, and slowly permeable.

Typically, the Mercedes soils are a calcareous gray clay to a depth of about 48 inches. The underlying layer to a depth of 80 inches is calcareous clay that is light brownish gray in the upper part and pale brown in the lower part.

The soils in this unit are used mostly as cropland. In a

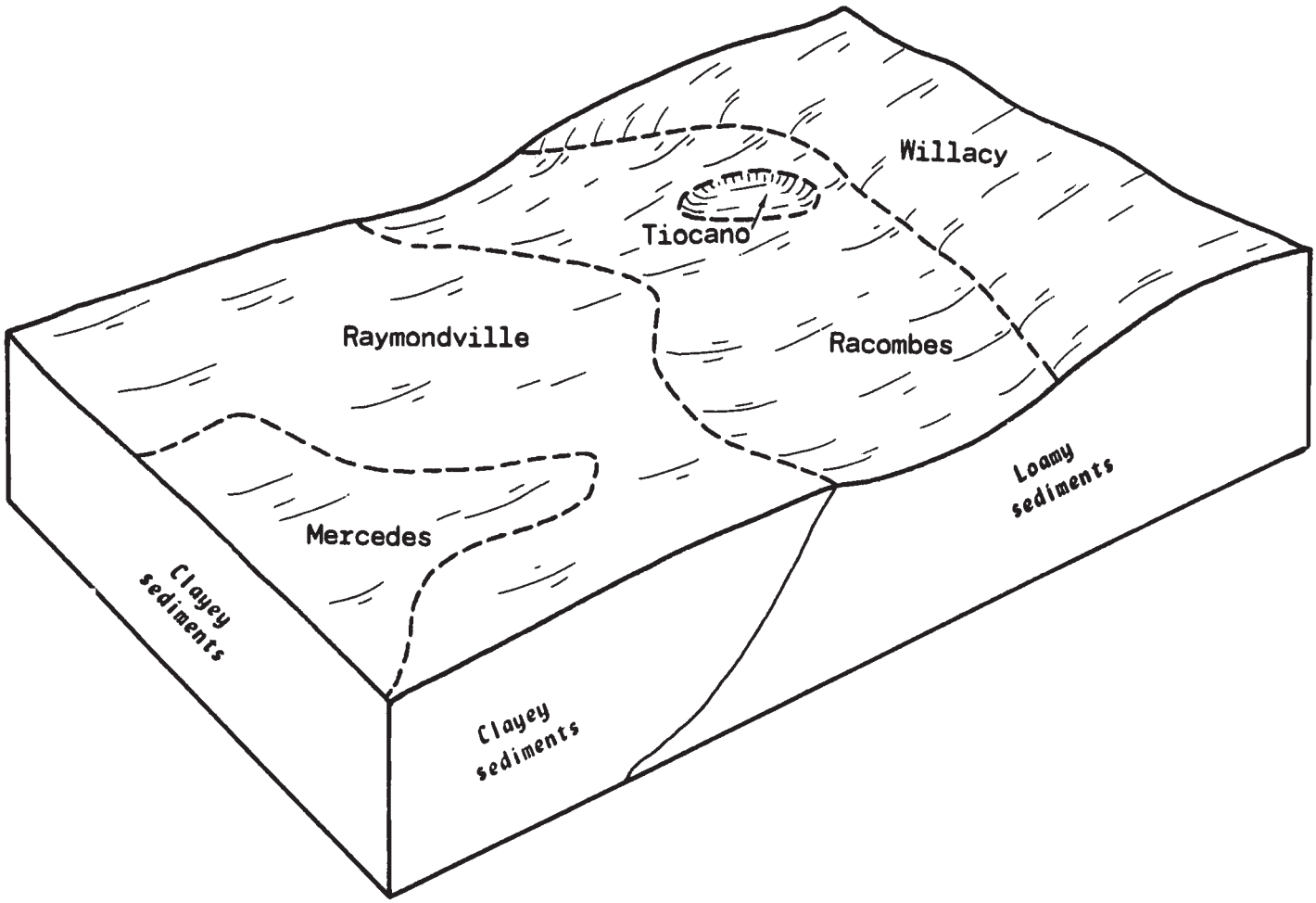


Figure 1.—Pattern of soils and underlying material on the middle and high stream terraces.

few small areas, they are used for improved pastureland and rangeland.

Most of the soils are well suited to moderately well suited to cropland and pastureland. The clayey texture and very slow and slow permeability are the main limitations. Cotton and grain sorghum are the main crops. Improved pastures are mainly Coastal bermudagrass.

Under proper management, rangeland produces a variety of grasses and large amounts of forage. Thorny brush has invaded many areas used as rangeland.

These soils are poorly suited to urban (fig. 2) and recreation uses. The clayey texture, very slow and slow permeability, slow surface runoff, and high shrink-swell potential are the main limitations.

2. Lyford-Lozano

Nearly level, neutral, nonsaline loamy soils

This map unit makes up about 13 percent of the county. It is about 32 percent Lyford soils, 28 percent Lozano soils, and 40 percent soils of minor extent, mainly Delfina, Rio, Tiocano, and Mercedes soils.

Typically, the Lyford soils have a surface layer of dark grayish brown sandy clay loam about 12 inches thick. The subsoil, to a depth of 40 inches, is sandy clay loam that is dark grayish brown in the upper part and brown in the lower part. The underlying material to a depth of 60 inches is light brown clay loam. These soils are moderately well drained and moderately permeable. They have a seasonal high water table within 3 to 5 feet of the surface.

Lozano soils typically have a surface layer of fine sandy loam about 16 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The subsoil, from 16 to 44 inches, is brownish sandy clay loam. Below that to a depth of 65 inches is pink sandy clay loam. These soils are somewhat poorly drained and moderately slowly permeable. They have a seasonal high water table within 1 to 3 feet of the surface.

The soils in this unit are used mostly as cropland. In a few areas, they are in improved pastureland and rangeland.

These soils are well suited to cropland and pastureland. Cotton and grain sorghum are the major crops. Improved pastures are mainly Coastal bermudagrass.

These soils are moderately well suited to irrigated citrus. Seasonal wetness is the main limitation for this crop.

Under proper management, rangeland produces a wide variety of grasses and moderately large amounts of forage. Thorny brush has invaded most areas used as rangeland.

These soils are moderately well suited to urban and recreation uses. Seasonal wetness is the main limitation to those uses.

3. Hidalgo-Racombes

Nearly level to gently sloping, neutral to moderately alkaline, nonsaline loamy soils

This map unit makes up about 11 percent of the county. It is about 42 percent Hidalgo soils, 31 percent Racombes soils, and 27 percent soils of minor extent, mainly Willacy and Hargill soils.

Typically, the Hidalgo soils have a surface layer of calcareous, grayish brown sandy loam about 14 inches thick. The subsoil, which extends to a depth of 42 inches, is calcareous sandy clay loam that is brown in the upper part and pale brown in the lower part. The underlying material to a depth of 60 inches is very pale brown clay loam with many soft masses of calcium carbonate. These soils are well drained and moderately permeable.

Typically, the Racombes soils have a dark gray sandy clay loam surface layer about 10 inches thick. The subsoil, which extends to a depth of 44 inches, is sandy clay loam that is grayish in the upper part and brownish in the lower part. The underlying material to a depth of 60 inches is calcareous pink clay loam with many masses of calcium carbonate. These soils are well drained and moderately permeable. They are seasonally wet after heavy rains.

The soils in this unit are used mostly as cropland. In a

Figure 2.—Street flooding after a heavy rain in an urban area of Raymondville clay loam. Surface runoff is slow.

few areas, they are used for improved pastureland and rangeland.

Most of the soils are well suited to cropland and pastureland. Cotton and grain sorghum are the main crops. Improved pastures are mainly in Coastal bermudagrass.

These soils are moderately well suited to irrigated citrus. Seasonal wetness is the main limitation for this crop.

Under proper management, rangeland can produce a variety of grasses, forbs, and shrubs and moderately large amounts of forage. Thorny brush has invaded most areas used as rangeland.

These soils are moderately well suited to urban and recreation uses. The moderate shrink-swell potential and seasonal wetness are the main limitations to those uses.

4. Willacy-Racombes

Nearly level to gently sloping, neutral and mildly alkaline, nonsaline loamy soils

This map unit makes up about 8 percent of the county. It is about 46 percent Willacy soils, 36 percent Racombes soils, and 18 percent soils of minor extent, mainly Delfina, Lyford, and Hidalgo soils.

Typically, the Willacy soils have a surface layer of grayish brown fine sandy loam about 14 inches thick. The subsoil, which extends to a depth of 44 inches, is brownish sandy clay loam. The underlying material to a depth of 65 inches is brownish, calcareous sandy clay loam with a few soft masses of calcium carbonate. These soils are well drained and moderately permeable.

Typically, the Racombes soils have a surface layer of dark gray sandy clay loam about 10 inches thick. The subsoil, which extends to a depth of 44 inches, is sandy clay loam that is grayish in the upper part and brownish in the lower part. The underlying material to a depth of 60 inches is calcareous pink clay loam with many masses of calcium carbonate. These soils are well drained and moderately permeable. They are seasonally wet after heavy rains.

The soils in this unit are used mostly as cropland. In a few areas, they are used for citrus, pastureland, and rangeland.

These soils are well suited to cropland and pastureland. Cotton and grain sorghum are the major crops. Sugarcane and a variety of vegetables are also grown in irrigated areas.

These soils are well suited to moderately well suited to irrigated citrus. Seasonal wetness is the main limitation for this crop.

Under proper management, rangeland produces a variety of grasses, forbs, and shrubs and moderately large amounts of forage. Thorny brush has invaded most areas used as rangeland.

The Willacy soils are well suited to urban and recreation uses, and the Racombes soils are not suited because of flooding or ponding. Wetness in low areas is another limiting factor.

5. Delfina-Hargill-Willacy

Nearly level to gently sloping, neutral to moderately alkaline, nonsaline loamy soils

This map unit makes up about 7 percent of the county. It is about 25 percent Delfina soils, 25 percent Hargill soils, 12 percent Willacy soils, and 38 percent soils of minor extent, mainly Racombes, Lyford, Rio, and Yturria soils.

The Delfina soils typically have a surface layer of fine sandy loam about 15 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The subsoil to a depth of 47 inches is sandy clay loam that is dark brown in the upper part, brown in the middle part, and light brown in the lower part. The lower part of the subsoil to a depth of 80 inches is reddish yellow, calcareous sandy clay loam. These soils are moderately well drained and moderately slowly permeable. They have a seasonal perched water table.

Typically, the Hargill soils have a grayish brown fine sandy loam surface layer about 14 inches thick. The upper part of the subsoil, which extends to a depth of 42 inches, is sandy clay loam that is dark brown in the upper part and brown in the lower part. The lower part of the subsoil to a depth of 65 inches is calcareous, reddish yellow sandy clay loam. These soils are well drained and moderately permeable.

Typically, the Willacy soils have a surface layer of grayish brown fine sandy loam about 14 inches thick. The subsoil, which extends to a depth of 44 inches, is brownish sandy clay loam. The underlying material to a depth of 65 inches is very pale brown, calcareous sandy clay loam with a few soft masses of calcium carbonate. These soils are well drained and moderately permeable.

The soils in this unit are used mostly as cropland. In a few areas, they are used for citrus, pastureland, and rangeland.

These soils are well suited to cropland and pastureland. Cotton and grain sorghum are the major crops. Sugarcane and a variety of vegetables are also grown in irrigated areas.

These soils are well suited to moderately well suited to irrigated citrus. Seasonal wetness is the main limitation on the Delfina and Racombes soils.

Under proper management, rangeland produces a variety of grasses, forbs, and shrubs and moderate yields of forage. Thorny brush has invaded most areas used as rangeland.

These soils are well suited to moderately well suited to urban uses and are well suited to recreation uses.

Wetness and moderate shrink-swell potential are the main limitations to those uses.

6. Willacy-Raymondville

Nearly level to gently sloping, neutral to moderately alkaline, nonsaline loamy soils

This map unit makes up about 2 percent of the county. It is about 40 percent Willacy soils, 30 percent Raymondville soils, and 30 percent soils of minor extent, mainly Hidalgo and Mercedes soils.

Typically, the Willacy soils have a grayish brown fine sandy loam surface layer about 14 inches thick. The subsoil, which extends to a depth of 44 inches, is brownish sandy clay loam. The underlying material to a depth of 65 inches is brownish, calcareous sandy clay loam with a few soft masses of calcium carbonate. These soils are well drained and moderately permeable.

Typically, the Raymondville soils have a grayish brown clay loam surface layer about 16 inches thick. The subsoil, which extends to a depth of 46 inches, is light brownish gray clay loam. The underlying material to a depth of 60 inches is very pale brown clay loam with many masses of calcium carbonate. These soils are moderately well drained and moderately permeable. They are seasonally wet after heavy rains.

The soils in this unit are used mostly as cropland. In a few small areas, they are used for improved pastureland and rangeland.

Under proper management, rangeland can produce a variety of grasses, forbs, and shrubs and moderately large yields of forage. Thorny brush has invaded most areas used as rangeland.

These soils are well suited to cropland and pastureland. Cultivated cotton and grain sorghum are the major crops.

The Willacy soils are well suited to urban and recreation uses. The Raymondville soils are poorly suited to urban and recreation uses. The clayey texture, slow permeability, and high shrink-swell potential are the main limitations to those uses.

Sandy soils of the eolian sand sheet and barrier island

This group of soils makes up about 16 percent of the county. These sandy soils are on nearly level flats and plains in the Port Mansfield area. They also are on gently undulating ridges and dunes on Padre Island. The main soils are Falfurrias, Galveston, Mustang, Nueces, Sarita, and Sauz soils. Most of the soils are in rangeland. A few are in improved pasture. The soils on Padre Island are in native vegetation or are barren and are used as recreation areas and wildlife habitat.

The eolian sand sheet (map units 7, 9, and 10) extends across the northern part of the county. It is made up of sandy material that was washed and blown out of the Gulf of Mexico (*9*).

The western part of the eolian sand sheet is underlain at varying depths in the smoother areas by a loamy subsoil. There are a few small ridges with axes oriented toward the prevailing winds, which give evidence of some wind action. This part of the sand sheet is older and more stable than the sands of the coastal area.

In the eastern part of the eolian sand sheet (map unit 10), the sands are of Recent age. The surface is nearly level to gently undulating and has a few low ridges and dunes. There are some large blowouts and active dunes, some of which are 25 to 40 feet above the general level of the area. The nearly level areas support prairie grasses and some wooded areas of mostly shrub live oaks, mustang grapes, and palms. Near the coast, most of these sands have a seasonal high water table.

The other areas of eolian, or wind-derived, soils (map unit 8) include those on Padre Island (fig. 3). This island has the typical dune relief. The material is similar to that of the eastern part of the "sand sheet" in the county. The sediments are being worked by wind.

7. Nueces-Sarita

Nearly level to gently undulating, neutral, nonsaline sandy soils

This map unit makes up about 7 percent of the county. It is about 65 percent Nueces soils, 13 percent Sarita soils, and 22 percent soils of minor extent, mainly Falfurrias and Sauz soils.

Typically, the Nueces soils have a fine sand surface layer about 29 inches thick that is light brownish gray in the upper part and very pale brown in the lower part. The subsoil to a depth of 32 inches is grayish brown fine sandy loam. From 32 to 78 inches, it is sandy clay loam that is grayish in the upper part and yellowish in the lower part. These soils are moderately well drained and are moderately slowly permeable. The hazard of soil blowing is severe.

Typically, the Sarita soils have a surface layer of brown fine sand about 30 inches thick. The subsurface layer, to a depth of 50 inches, is very pale brown fine sand. The subsoil to 80 inches is a sandy clay loam that is light gray in the upper part and very pale brown in the lower part and has brownish and reddish mottles. These soils are well drained and moderately rapidly permeable. They have a severe hazard of soil blowing.

Most of the acreage is used as rangeland. A few areas are in improved pastureland.

Under proper management, rangeland produces a wide variety of grasses and forbs and moderately large forage yields. Mesquite has invaded most areas.

These soils are moderately well suited to pastureland. Low to moderate available water capacity and the severe hazard of soil blowing are the main limitations. Improved pastures are mainly Coastal bermudagrass and weeping lovegrass.

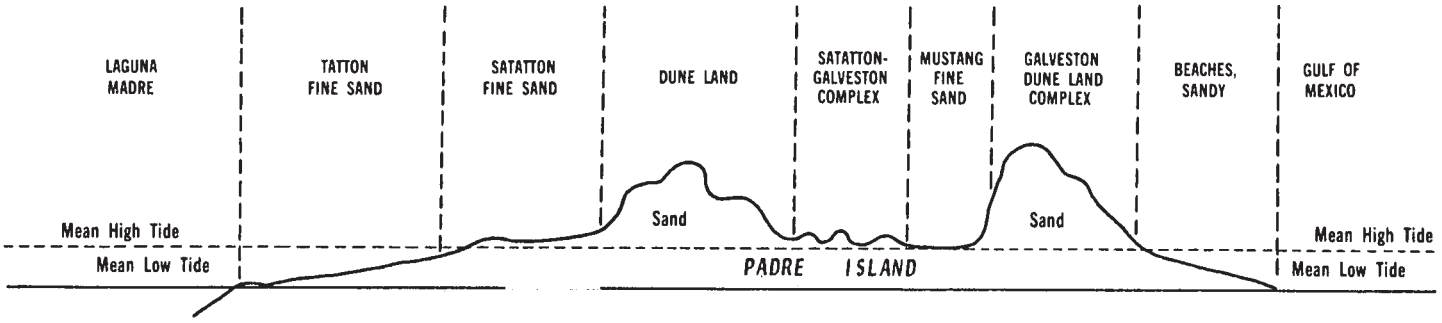


Figure 3.—Cross section of Padre Island showing a typical sequence of soils.

These soils are poorly suited to cropland. The severe hazard of soil blowing is the major limitation for cropland use.

These soils are well suited to most urban and recreation uses. The sandy texture is a limitation for some of these uses.

8. Galveston-Mustang-Dune land

Nearly level to gently undulating, moderately alkaline, nonsaline sandy soils and undulating to rolling Dune land

This map unit makes up about 4 percent of the county. It is about 47 percent Galveston soils, 25 percent Mustang soils, 19 percent Dune land, and 9 percent soils of minor extent, mainly Beaches and Tatton and Arrada soils.

Galveston soils typically have a calcareous surface layer of light brownish gray fine sand about 6 inches thick. From 6 to 60 inches is calcareous fine sand that is grayish in the upper part and brownish in the lower part. These soils are somewhat excessively drained and are rapidly permeable. Soil blowing is a severe hazard.

Mustang soils typically have a calcareous, light brownish gray surface layer of fine sand about 8 inches thick. The underlying material to a depth of 60 inches is calcareous, light gray fine sand. These soils are poorly drained and rapidly permeable. In these soils the water table is at the surface or at a depth of no more than 0.5 foot.

Dune land consists of very pale brown or light brownish gray, loose fine sand to a depth of more than 80 inches. The sands are excessively drained and rapidly permeable. They make up active dunes, where sand blowing is severe during strong winds.

The soils in this unit are used mostly as rangeland. The areas on Padre Island are used for wildlife habitat and recreation.

The soils are moderately well suited to pastureland. Low available water capacity and a severe hazard of soil blowing are the major limitations. In well managed rangeland, a variety of grasses and forbs and moderately low forage yields are produced.

These soils are not suited to cropland. Low available water capacity and a severe hazard of soil blowing are the main limitations.

These soils are not suited to urban uses, primarily because of the flood hazard. The severe hazard of soil blowing, slope, and wetness are other limitations.

The recreation areas on the beach are used for hiking and picnicking and are well suited to those uses.

9. Sauz

Nearly level, mildly alkaline to strongly alkaline, saline sandy soils

This map unit makes up about 3 percent of the county. It is about 75 percent Sauz soils and 25 percent soils of minor extent, mainly Nueces, Sarita, and Willamar soils (fig. 4).

The Sauz soils typically have a surface layer of light brownish gray, saline loamy fine sand about 7 inches thick. The upper part of the subsoil, from 7 to 13 inches, is saline, grayish brown sandy loam. The middle part, from 13 to 40 inches, is saline, light brownish gray sandy clay loam. To a depth of 65 inches is grayish, saline, calcareous fine sandy loam. These soils are somewhat poorly drained and moderately slowly permeable. They have a seasonal water table at 1 to 3 feet below the surface.

The soils in this unit are used as rangeland.

These soils are moderately well suited to pastureland, mostly Coastal bermudagrass. Excess sodium, seasonal wetness, and moderate to low available water capacity

are the main limitations. Under proper management, rangeland can produce a variety of grasses and moderately large amounts of forage.

These soils are poorly suited to cropland. Wetness, salinity, and a severe hazard of soil blowing are the main limitations.

These soils are poorly suited to most urban and recreation uses. Excess sodium and wetness are the main limitations to those uses.

10. Falfurrias

Gently undulating, neutral and mildly alkaline, nonsaline sandy soils

This map unit makes up about 2 percent of the county. It is about 65 percent Falfurrias soils and 35 percent soils of minor extent, mainly Nueces, Sarita, and areas of active sand dunes.

Falfurrias soils typically have a surface layer of fine sand about 30 inches thick. It is grayish in the upper part and brownish in the lower part. The underlying material to a depth of 80 inches is brownish fine sand. These soils are somewhat excessively drained and rapidly permeable, and they have a severe hazard of soil blowing. Reaction is typically neutral to mildly alkaline throughout.

The soils in this unit are used as rangeland and wildlife habitat. Low available water capacity and the hazard of soil blowing are the main limitations. In rangeland, under proper management, a variety of grasses and moderately low amounts of forage are produced. Oak trees cover about 50 percent of the map unit. In some areas, a few mesquite have invaded.

These soils are poorly suited to cropland and pastureland. The low available water capacity and severe hazard of soil blowing are the main limitations.

These soils are well suited to most urban and recreation uses; however, the sandy texture is a limitation for some of those uses.

Loamy and clayey soils of the low coastal terrace and barrier island

This group of soils makes up about 18 percent of the county. It consists of loamy and clayey, saline soils on nearly level flats and low ridges. The main soils are

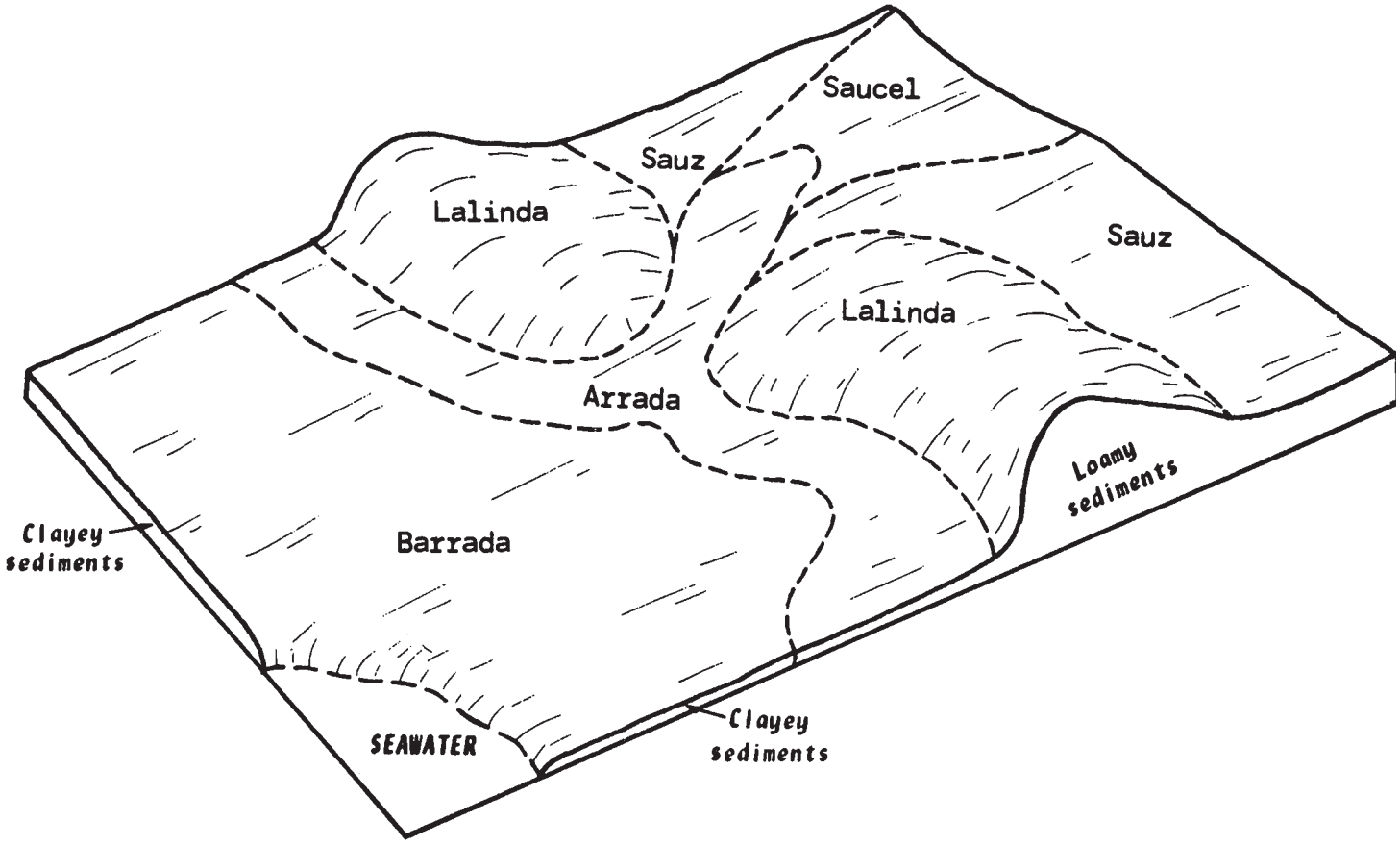


Figure 4.—Pattern of soils and underlying material in the Sauz and Barrada-Lalinda-Arrada map units near the bay.

Arrada, Barrada, Lalinda, Latina, Porfirio, Satatton, Saucel, Tatton, and Willamar soils. A few areas of the soils are used as cropland. Most of the acreage is rangeland. The principal vegetation is gulf cordgrass and other salt-loving plants, such as sea orange and seaside heliotrope.

The low coastal terraces are adjacent to Laguna Madre and extend inland from one-fourth mile to more than 15 miles. Next to the bay are chiefly flat basins and lagoons. Some are long narrow areas, and others are broad areas of considerable size.

On the area nearest the coast, the elevation is so slight that some of these areas may be covered by saltwater from Laguna Madre when a high wind forces the water over the low coastal beach bar. Because little of the saltwater finds its way back to the sea, moisture evaporates and salt is deposited in the depressions. The parent material consists largely of sediments deposited by freshwater in shallow saltwater and then reworked by marine forces. During this process, a large amount of sodium chloride and other salts are incorporated with the soil material. This salt content is sufficient to inhibit or prevent the growth of vegetation.

Both the marine plain and the area of saline soils to the west are underlain at a shallow depth by saltwater, which during rainy seasons rises and occupies small lake basins. Some of these small lakes were probably at one time part of old river channels.

The high salt content of the soils in the basins and old channels is responsible for a series of mounds and elongated ridges lying 5 to 25 feet above the level of the surrounding country (*13*). The mounds and ridges are on the leeward sides of the depressions, or basins, and are the result of both chemical and wind action. When dry, the salty soils of the basins become fluffy and loose as a result of the action of the salt on the soil structure, and they are readily taken up by the prevailing winds and deposited on the northwestern sides of the depressions. The resulting ridges have contours typical of dunes. Most of the mounds and ridges are nearly symmetrical, though many are incipient, or immature, dunes.

11. Satatton-Tatton

Nearly level, moderately alkaline and strongly alkaline, saline sandy soils

This map unit makes up about 6 percent of the county. It is about 50 percent Satatton soils, 48 percent Tatton soils, and 2 percent soils of minor extent, mainly Mustang and Sauz soils.

The Satatton soils are extremely saline and calcareous throughout. Typically, the surface layer is a very pale brown fine sand about 6 inches thick. The underlying material to a depth of 60 inches is light gray fine sand with brownish mottles. These soils are poorly drained and rapidly permeable. They have a saline water table at 1 to 3 feet of the surface.

The Tatton soils are extremely saline and calcareous throughout. Typically, the surface layer is a light gray fine sand about 5 inches thick. The next 7 inches is gray loamy fine sand. The underlying material to a depth of 60 inches is light gray fine sand. These soils are very poorly drained and rapidly permeable. They are flooded by seawater a part of the year.

The soils in this unit are used mostly for recreation and as wetland for waterfowl.

These soils are not suited to cropland, rangeland, pastureland, or urban and recreation uses. Flooding, wetness, excess salt, excess sodium, and sandy texture are the main limitations to those uses.

12. Willamar-Porfirio

Nearly level, neutral to moderately alkaline, saline loamy soils

This map unit makes up about 5 percent of the county. It is about 43 percent Willamar soils, 37 percent Porfirio soils, and 20 percent soils of minor extent, mainly Incell, Jarron, and Sauz soils.

Typically, the Willamar soils have a surface layer of fine sandy loam about 6 inches thick that is grayish brown in the upper part and gray in the lower part. The subsoil, from 6 to 28 inches, is sandy clay loam that is grayish in the upper part and brownish in the lower part. The underlying material from 28 to 65 inches is saline very pale brown clay loam that grades to sandy clay loam in the lower part. These soils are somewhat poorly drained and very slowly permeable. They have a very low available water capacity and a seasonal water table within 3 to 6 feet of the surface.

The Porfirio soils are saline and calcareous throughout. Typically, the surface layer is a dark gray sandy clay loam about 12 inches thick. The subsoil, from 12 to 36 inches, is light brownish gray clay loam. The underlying material to a depth of 65 inches is brownish and grayish clay loam with yellowish brown mottles and many masses of segregated salts and calcium carbonate. These soils are moderately well drained and slowly permeable. They have a seasonal saline water table within 2 to 4 feet of the surface.

The soils in this unit are used mostly for rangeland and improved pastureland. A few areas are in cropland.

These soils are poorly suited to cropland. Salinity and wetness are the main limitations. Cotton and grain sorghum are the main crops.

The soils are moderately well suited to pastureland. Excess sodium, very low to moderate available water capacity, and wetness are the main limitations. Suitable grasses for improved pasture are Coastal bermudagrass and African stargrass.

In rangeland, under good management, a variety of

grasses and high yields of forage can be produced. Gulf cordgrass is the main grass.

These soils are poorly suited to most urban and recreation uses. Wetness, excess salt, and excess sodium are the main limitations to those uses.

13. Barrada-Lalinda-Arrada

Nearly level to gently sloping, mildly alkaline to strongly alkaline, saline and nonsaline clayey and loamy soils

This map unit makes up about 4 percent of the county. It is about 45 percent Barrada soils, 19 percent Lalinda soils, 13 percent Arrada soils, and 23 percent soils of minor extent, mainly Mustang, Satatton, and Willamar soils.

Barrada soils typically are a gray, extremely saline, calcareous clay to a depth of about 40 inches. The underlying material to a depth of 60 inches is extremely saline, calcareous sandy clay loam that is grayish in the upper part and olive in the lower part. These soils have very low available water capacity. They are very poorly drained and are very slowly permeable.

Lalinda soils typically have a sandy clay loam surface layer about 6 inches thick. It is grayish brown in the upper part and gray in the lower part. The upper part of the subsoil, from 6 to 30 inches, is calcareous, grayish brown sandy clay loam that grades to light brownish gray in the lower part. The lower part of the subsoil, from 30 to 56 inches, is calcareous, light gray sandy clay loam. The underlying material to a depth of 72 inches is light gray, calcareous sandy clay loam with many threads and films of lime in the lower part. These soils are well drained and moderately slowly permeable. They have a severe hazard of water erosion.

Arrada soils typically consist of a calcareous, extremely saline sandy clay loam, which extends to a depth of 80 inches. It is gray in the upper part, white in the middle part, and greenish gray in the lower part. These soils are poorly drained and moderately slowly permeable. They have very low available water capacity.

The Barrada and Arrada soils, which make up about 60 percent of the unit, are barren of vegetation. They are not suited to cropland, rangeland, pastureland, and urban or recreation uses. Wetness, excess salt, excess sodium, and the flood hazard are the main limitations. When ponded, the areas provide suitable habitat for ducks, geese, herons, and other waterfowl.

The Lalinda soils are moderately well suited to pastureland. The severe hazard of water erosion is the main limitation. Coastal bermudagrass is a suitable grass for improved pasture.

In rangeland, under proper management, these soils produce moderately high yields of forage. Most areas have a low canopy of thorny bush.

The Lalinda soils can be used for crops but are poorly suited. Yields are generally low because of salinity.

The soils are moderately well suited to most urban and recreation uses.

14. Saucel-Latina

Nearly level, moderately alkaline and strongly alkaline, saline loamy soils

This map unit makes up about 3 percent of the county. It is about 52 percent Saucel soils, 35 percent Latina soils, and 13 percent soils of minor extent, mainly Jarron, Sauz, and Willamar soils.

Saucel soils are calcareous and extremely saline throughout. Typically, the surface layer is light brownish gray sandy loam about 4 inches thick. The subsoil, from 4 to 44 inches, is light gray sandy loam. The underlying material to a depth of 62 inches is gray loamy sand in the upper part and grades to light olive gray sandy clay loam in the lower part. These soils are poorly drained and moderately permeable. They have a seasonal water table at 0.5 foot to 2 feet of the surface.

Latina soils are saline throughout. Typically, the surface layer is a gray sandy clay loam about 4 inches thick. The subsoil, from 4 to 26 inches, is calcareous sandy clay loam that is gray in the upper part and light brownish gray in the lower part. The underlying material to a depth of 60 inches is light brownish gray sandy clay loam with brownish mottles and many soft masses of salts and calcium carbonate. These soils are poorly drained and slowly permeable. They have a seasonal water table at 1 foot to 3 feet of the surface.

The soils in this unit are used as rangeland.

In rangeland, droughtiness, salinity, and wetness are the main limitations. Under good management, a variety of salt-tolerant grasses and forbs can be produced. Forage yields are moderately low.

These soils are not suited to cropland and pastureland. Droughtiness, salinity, and wetness are the major limitations. To make these soils suited to those uses, major surface and subsurface drainage systems for reducing wetness and salinity are needed.

These soils are not suited to urban and recreation uses, primarily because of the flood hazard. Wetness, excess salt, and excess sodium are other limitations to those uses.

Detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Raymondville clay loam, saline, is one of several phases in the Raymondville series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Galveston-Mustang complex, gently undulating, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas support little or no vegetation. Beaches, sandy, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil descriptions

An—Arents, loamy. These deep, nearly level soils are on middle and high stream terraces. Slopes are less than 0.5 percent. Areas are small and rounded and range from 5 to 25 acres.

Arents, loamy, are soils that have been drastically modified by heavy machinery in leveling land for irrigation. These soils fill depressions in the original landscape and are 24 to 48 inches thick. Racombes, Rio, and Tiocano soils now underlie the Arents soils. Some of the soils that have been mixed and then deposited as Arents are the Delfina, Hidalgo, Hargill, and Willacy soils.

The Arents are made up of fine sandy loams or sandy clay loams that are friable, neutral to moderately alkaline, very dark grayish brown, dark grayish brown, grayish brown, brown, dark brown, strong brown, reddish brown, or pale brown.

These soils are moderately well drained, and surface runoff is slow. Permeability is moderately slow. The available water capacity is moderate. A perched water table occurs for a few days after heavy rains or irrigation. The root zone is deep. The hazards of water erosion and soil blowing are slight.

Included in mapping are small areas of Hidalgo, Racombes, and Raymondville soils. These included soils make up less than 15 percent of any mapped area.

Areas of these soils are used mainly as cropland. A few areas are in pasture.

These soils are well suited to most crops. Improving subsurface drainage is the main need. Suitable crops are cotton and grain sorghum.

These soils are poorly suited to irrigated citrus. Poor subsurface drainage is the main limitation.

These soils are well suited to pasture. Proper management that includes fertilization, rotational grazing, and weed control are needed to maintain productivity. Suitable grasses are Coastal bermudagrass and African stargrass.

These soils are poorly suited to most urban and recreation uses. Slow permeability, slow surface drainage, and high shrink-swell potential are the major limitations to those uses.

Arents, loamy, are in capability subclass IIw, nonirrigated or irrigated. No range site has been assigned to this unit.

Ar—Arrada sandy clay loam. This soil is on salt flats and in drainageways near the coast and in saline lakes. The surface is nearly level to concave. Slopes are less than 1 percent. Areas are irregularly shaped and range from 40 to 1,000 acres.

This soil is extremely saline and strongly alkaline throughout. Typically, the surface layer is gray sandy clay loam about 5 inches thick. From 5 to 32 inches, the soil material is gray sandy clay loam mottled with dark brown and olive brown. From 32 to 54 inches, it is white sandy clay loam mottled with yellowish brown. Below that to a depth of 80 inches is light greenish gray sandy clay loam.

This soil is poorly drained. Runoff is slow. Some areas are periodically ponded. Gulf storms and large rains frequently flood most areas. A permanent water table is 1 to 4 feet below the surface. Permeability is moderately slow. Available water capacity is very low. The erosion hazard is slight.

Included in mapping are small areas of Lalinda, Sauz, and Saucel soils on low ridges and Barrada soils in depressions. These included soils make up less than 25 percent of any one mapped area.

This soil is mainly used as wildlife habitat. Ducks, geese, gulls, herons, and other waterfowl use ponded areas.

Other uses of this soil are restricted because the soil is extremely saline and wet and is barren of vegetation. The soil is not suited to urban uses, crops, rangeland, or most recreation uses. Of minor extent are sites near the beach for riding motorcycles and other recreational vehicles.

This soil is in capability subclass VIIIs. It has not been assigned to a range site.

Ba—Barrada clay. This nearly level soil is on low salt flats next to the coast. It is usually ponded. Slopes are less than 0.5 percent. Areas are round to irregularly oblong and range from about 40 to 600 acres.

Barrada clay is wet and strongly alkaline and extremely saline. Typically, the upper part of this soil, to a depth of about 40 inches, is gray clay interbedded with salt. Below that to a depth of 60 inches is sandy clay loam that is light greenish gray in the upper part and pale olive in the lower part.

This soil is very poorly drained. Some areas are ponded at times, and others have very slow runoff. A permanent saline water table is 1 foot to 3 feet below the surface. This soil is usually dry during summer. Permeability is very slow. Available water capacity is very low. The erosion hazard is none to slight.

Included in mapping are small areas of Latina and Lomalta soils on slight rises that are vegetated. Also included are small areas of Arrada soils on the outer edge of the mapped areas. These included soils make up less than 25 percent of any one mapped area.

This soil is mainly used as wildlife habitat. Ducks, geese, gulls, herons, and other waterfowl use ponded areas.

Other uses of this soil are restricted because of the extreme salinity and wetness of the soil and also because the soil is barren of vegetation. The soil is not suited to urban uses, crops, range, or most recreation uses. Of minor extent are sites near the beach for hiking and for riding motorcycles and other recreational vehicles.

This soil is in capability subclass VIIIs. It has not been assigned to a range site.

Bg—Beaches, gravelly. Areas of this map unit are on the mainland side of Laguna Madre. The beaches are gravelly and sandy and have shells and concretions on much of the surface. Areas are long and narrow, averaging about 200 feet wide. They range from about 2 feet below to about 2 feet above mean sea level.

Beaches, gravelly, consist of gravelly and sandy, strongly alkaline soils that formed in marine sediments. Typically, the surface layer is gray very gravelly sand about 6 inches thick. It is about 40 percent by volume shell fragments and concretions. From 6 to 18 inches is dark gray sandy clay loam. From 18 to 44 inches is sandy clay loam that is dark grayish brown in the upper part and grayish brown mottled with olive and yellowish brown in the lower part. The underlying material to a depth of 60 inches is light olive brown sandy clay loam mottled with brownish yellow.

These areas are very poorly drained. The surface is frequently flooded by tides and washed with waves. When the beaches are not flooded with seawater, the water table is 0 to 1 foot below the surface.

The areas are used for recreation. The beaches give moderate support to vehicle traffic if not saturated with water. During seasons of high tides, some seaweeds and mosses grow on the beaches. A large variety of small animals such as sand crabs, worms, water bugs, dragonflies, and insects thrive along the beaches and supply food for birds and fish. The shell fragments on the surface are a nuisance for picnickers, sunbathers, and swimmers.

These areas are not suited to other uses because of flooding, tides, lack of vegetation, and salinity.

The soils in this unit are in capability subclass VIIIw. They have not been assigned to a range site.

Bs—Beaches, sandy. This map unit consists of strongly alkaline soils that formed in marine sediments. These soils are on the gulf side of south Padre Island and have sea shells scattered on the surface. Areas are long and narrow, about 300 feet wide, and 2 feet below to 3 feet above mean sea level.

Typically, the surface layer is light gray fine sand about 24 inches thick. The underlying material to a depth of 60 inches is light gray coarse sand that has many sand-size seashell fragments.

Beaches, sandy, are poorly drained. The surface is frequently flooded by tides or washed by waves during coastal storms. When the beaches are not covered with seawater, the water table is 0 to 2 feet below the surface. Sand blowing occurs during strong winds. Salt-water spray and a high evaporation rate cause the content of soluble salt to be high.

The areas are used only for recreation. The beaches give moderate support to vehicle and foot traffic when wet. A large variety of small animals such as sand crabs and insects thrive along the beaches and supply food for birds and fish.

The areas are not suited to other land uses. Flooding, salinity, and sand blowing are the main limitations.

The soils in this unit are in capability subclass VIIIw. They have not been assigned to a range site.

Ca—Camargo silty clay loam. This soil is on the flood plains of the Arroyo Colorado. Slopes are less than 1 percent. Areas are long and narrow and range from 10 to 600 acres.

Typically, the surface layer is grayish brown silty clay loam about 9 inches thick. From 9 to 42 inches, the soil material is pale brown silty clay loam in the upper part and very pale brown silt loam in the lower part. The next layer, from 42 to 53 inches, is grayish brown clay loam. The underlying material to a depth of 65 inches is pale brown clay. The soil is calcareous and moderately alkaline throughout.

This soil is well drained. Surface runoff is slow. Permeability is moderate. Available water capacity is high. The erosion hazard is slight, although some deep gullies have been cut near the streambanks. Since the deep dredging of the Arroyo Colorado as a ship channel, this soil is no longer subject to flooding.

Included in mapping are small areas of Porfirio, Raymondville, and Hidalgo soils. In some areas, up to 2 feet of loamy dredge material of the Arroyo Colorado has been deposited on the surface. These included soils make up less than 25 percent of any one mapped area.

This soil is used mostly as rangeland and wildlife habitat.

For rangeland, brush control, controlled grazing, and proper stocking are needed to maintain productivity.

The potential plant community is mid grasses, forbs, and woody plants. The better grasses are fourflower trichloris, Arizona cottontop, plains bristlegrass, and sand dropseed. Hooded windmillgrass, slim tridens, and threeawn increase under heavy grazing.

The major forbs and woody plants are mesquite, spiny hackberry, sensitivebriar, dalea, and bushsunflower. If heavy grazing occurs for many years, mesquite and thorny brush will dominate. The potential production per acre when the range is in excellent condition is 7,000 pounds, dry weight, in favorable years and 3,000 pounds in unfavorable years.

This soil is well suited to pasture grasses. Fertilization, rotational grazing, and weed control are needed to maintain productivity. Suitable grasses are Coastal bermudagrass, buffelgrass, and bluestem.

This soil is well suited to crops. Cropping systems that include crops that produce large amounts of residue are needed to maintain soil tilth. Suitable crops are cotton and grain sorghum.

This soil is moderately well suited to urban and recreation uses. The moderately low strength, which affects roads and streets, and the moderate shrink-swell potential are the main limitations.

This soil is in capability subclass IIIc and the Loamy Bottomland range site.

DeA—Delfina loamy fine sand, 0 to 2 percent slopes. This deep soil is on low ridges of high stream terraces. The surface is plane to concave. Areas are irregular and range from 20 to 200 acres.

Typically, the surface layer is neutral, grayish brown loamy fine sand about 17 inches thick. The upper part of the subsoil, which extends from 17 to 32 inches, is neutral sandy clay loam. It is grayish brown in the upper part and light brownish gray in the lower part. The middle part of the subsoil, from 32 to 44 inches, is mildly alkaline, pale brown sandy clay loam. The lower part of the subsoil to a depth of 65 inches is moderately alkaline, light yellowish brown sandy clay loam.

This soil is moderately well drained. Surface runoff is slow or medium. Permeability is moderately slow. The available water capacity is moderate. The hazard of soil blowing is severe, and the hazard of water erosion is slight. A perched water table occurs on top of the subsoil for a few hours after heavy rains. A seasonal water table is 2.5 to 5 feet below the surface.

Included in mapping are small areas of Hargill, Racombes, and Nueces soils. These included soils make up less than 25 percent of any one mapped area.

This soil is used mostly as rangeland.

In rangeland, brush control, proper stocking, and controlled grazing are needed to maintain productivity. The potential plant community is mid and tall grasses and some forbs and woody plants. The better grasses

are seacoast bluestem, Texas cottontop, silver bluestem, and plains bristlegrass. Hooded windmillgrass, paspalums, and perennial threeawns increase under heavy grazing. The major forbs and woody plants are mesquite, hackberry, wolfberry, bushsunflower, croton, and annual forbs. If heavy grazing occurs for many years, mesquite and thorny brush will dominate. The potential production per acre when the range is in excellent condition is 4,500 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

This soil is well suited to pasture grasses. Controlled grazing, fertilization, and weed control are needed to maintain productivity. The suitable grasses are Coastal bermudagrass, buffelgrass, and introduced bluestems.

This soil is moderately well suited to crops. Suitable crops are cotton and grain sorghum. The hazard of soil blowing is the main limitation. Leaving crop residue on the surface helps to control soil blowing.

This soil is moderately well suited to urban uses. The moderate shrink-swell potential and seasonal wetness are the main limitations. The soil is well suited to recreation uses.

This soil is in capability subclass IIIe and the Loamy Sand range site.

DfA—Delfina fine sandy loam, 0 to 1 percent slopes. This nearly level soil is on low ridges on high stream terraces. The surface is plane to convex. Areas are oblong and range from 20 to 100 acres.

Typically, the surface layer is neutral, grayish brown to dark grayish brown fine sandy loam about 15 inches thick. The upper part of the subsoil, from 15 to 33 inches, is neutral, brownish sandy clay loam with reddish and brownish mottles. The middle part of the subsoil, which extends from 33 to 47 inches, is mildly alkaline, brownish sandy clay loam with grayish brown mottles. The lower part of the subsoil from 47 to 80 inches is moderately alkaline, reddish yellow sandy clay loam with common calcium carbonate concretions.

This soil is moderately well drained. Surface runoff is slow to medium. Permeability is moderately slow. Available water capacity is moderate. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. A perched water table occurs on top of the subsoil for a few hours after heavy rains or after irrigation. A seasonal water table is 2.5 to 5 feet below the surface.

Included in mapping are small areas of Willacy, Hargill, and Racombes soils, mainly on the outer edge of the mapped areas. Also included, in small depressions, are soils that are similar to the Delfina soil but have a sandy clay subsoil. These included soils make up less than 15 percent of any one mapped area.

This soil is used mostly as cropland and is well suited to this use. Cropping systems that include crops that produce large amounts of residue are needed to maintain soil tilth. Suitable nonirrigated crops are cotton and grain sorghum, and suitable irrigated crops are sugarcane and a wide variety of vegetables. The soil is moderately well suited to irrigated citrus. Land leveling can help to increase the efficiency of irrigation. Tile drains can be used to lower the seasonal high water table in irrigated areas.

This soil is well suited to pasture grasses. Proper management that includes fertilization, controlled grazing, and weed control are needed to maintain productivity. Suitable grasses are Coastal bermudagrass, buffelgrass, and introduced bluestems.

Some areas are in rangeland. Controlled grazing and proper stocking are needed to maintain productivity The potential plant community is mid grasses and some forbs and woody plants. The better grasses are twoflower trichloris, fourflower trichloris, Arizona cottontop, and plains bristlegrass. Hooded windmillgrass, fall witchgrass, threeawn, and buffalograss increase under heavy grazing. If heavy grazing occurs for many years, mesquite and thorny brush will dominate. The potential production per acre when the range is in excellent condition is 4,000 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

This soil is moderately well suited to urban uses. The moderate shrink-swell potential and seasonal wetness are the main limitations. The soil is well suited to recreation uses.

This soil is in capability subclass IIs, nonirrigated, and IIw, irrigated. It is in the Tight Sandy Loam range site.

DfB—Delfina fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping soil is on ridges of high stream terraces. The surface is plane to convex. Areas are roundish and range from 10 to 80 acres.

Typically, the surface layer is neutral, grayish brown fine sandy loam about 13 inches thick. From 13 to 36 inches, the subsoil is neutral sandy clay loam that is dark brown in the upper part and brown mottled with reddish brown in the lower part. From 36 to 50 inches, the subsoil is mildly alkaline, light brown sandy clay loam with a few masses of calcium carbonate. The lower part of the subsoil to a depth of 65 inches is moderately alkaline, light brown sandy clay loam mottled with olive and has a few concretions of calcium carbonate.

The soil is moderately well drained. Surface runoff is medium. Permeability is moderately slow. Available water capacity is high. The erosion hazard is medium. A perched water table occurs on top of the subsoil for a few hours after heavy rains or irrigation. In irrigated or fallow areas, a seasonal water table is 2.5 to 5 feet below the surface.

Included in mapping are small areas of Hargill, Lozano and Racombes soils. These included soils make up less than 15 percent of any one mapped area.

This soil is used mostly as cropland, for which it is well suited. Cropping systems that include crops that produce large amounts of residue are needed to maintain soil

tilth. Suitable nonirrigated crops are cotton and grain sorghum, and suitable irrigated crops are sugarcane and a wide variety of vegetables. Land leveling can help to increase the efficiency of irrigation. Tile drains can be used to lower the seasonal high water table. Bedding the soil and proper use of crop residue when fallowing will reduce soil blowing. Farming on the contour or across the grade helps to control water erosion.

This soil is moderately well suited to irrigated citrus. The seasonal wetness and moderately slow permeability are the main limitations. Subsurface drains can be used to lower the water table that generally occurs under irrigation.

This soil is well suited to pasture grasses. Proper management that includes fertilization, controlled grazing, and weed control are needed to maintain productivity. Suitable grasses are Coastal bermudagrass, buffelgrass, and introduced bluestem.

This soil is well suited to rangeland. Controlled grazing and proper stocking are needed to maintain productivity. The potential plant community is mid grasses and some forbs and woody plants. The better grasses are twoflower trichloris, fourflower trichloris, Arizona cottontop, and plains bristlegrass.

Hooded windmillgrass, fall witchgrass, threeawn, and buffalograss increase under heavy grazing. If heavy grazing occurs for many years, mesquite and thorny brush will dominate. The potential production per acre when the range is in excellent condition is 4,000 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

This soil is moderately well suited to most urban uses. The moderate shrink-swell potential and seasonal wetness are the main limitations. The soil is well suited to most recreation uses.

This soil is in capability subclass IIIe, nonirrigated, and IIe, irrigated. It is in the Tight Sandy Loam range site.

Dn—Dune land. This miscellaneous area consists of undulating to rolling, active dunes on Padre Island and on the sand sheet in the northeastern part of the county (fig. 5). The sand dunes are 7 feet to more than 20 feet high. The dunes are in ridges oriented in a southwest to northeast direction and are perpendicular to the

Figure 5.—Dune land on the mainland. Sand blowing during strong winds is severe.

prevailing southeast winds. Areas are irregularly shaped and range from 20 to 600 acres.

Typically, the dunes on the mainland consist of neutral, very pale brown fine sand more than 80 inches thick. The dunes on Padre Island are made up of alkaline, light brownish gray fine sand more than 80 inches thick.

The sand dunes are excessively drained. Surface runoff is none to slow. Permeability is rapid. Available water capacity is very low. The hazard of sand blowing during strong winds is severe.

Included in mapping are small areas of Falfurrias and Galveston soils, on the outer edge of the unit, and Mustang soils in blowouts. Satatton soils are the main included soils in this unit on Padre Island. The included soils make up less than 25 percent of any one mapped area.

These sand dunes support no vegetation. On the mainland, they are used by cattle as bedding grounds and as a place to escape insect pests, mainly flies and mosquitos. The blowouts are commonly a source of water for livestock and wildlife during the wet season. On Padre Island the sand dunes are used mainly for recreation.

Dune land is not suited to most common land uses. The dunes have no vegetation and require major reclamation to vegetate and stabilize them. Active wind erosion, loose sand, rapid permeability, and low available water capacity are the main limitations. The dunes are subject to the damaging effects of coastal storms.

Dune land is in capability subclass VIIIe. It has not been assigned to a range site.

FaB—Falfurrias fine sand, gently undulating. This soil is on low ridges. Slopes are 1 to 5 percent. Areas are irregularly shaped and range from 100 to more than 1,000 acres.

Typically, the surface layer is fine sand about 30 inches thick. It is grayish and mildly alkaline in the upper part and brownish and neutral in the lower part. Below this to a depth of 80 inches is mildly alkaline, very pale brown fine sand.

This soil is deep and somewhat excessively drained. Runoff is none to slow. Permeability is rapid. Available water capacity is low. The hazard of soil blowing is severe, and the hazard of water erosion is slight.

Included in mapping are small areas of Sarita and Galveston soils. These included soils make up less than 15 percent of any one mapped area.

In most areas, this soil is used as rangeland and wildlife habitat. Low available water capacity and low fertility are the main limitations.

In rangeland, proper management that includes controlled grazing is needed to maintain productivity. The potential plant community is an open prairie of tall grasses and scattered motts of shrub live oak and mesquite. The dominant grasses are seacoast bluestem, big bluestem, and balsamscale. Sand dropseed, hooded windmillgrass, perennial threeawn, brownseed paspalum, and knotroot bristlegrass increase under heavy grazing. If heavy grazing is prolonged, woody vegetation will increase and low-quality grasses and plants such as red lovegrass, sandbur, crabgrass, snakecotton, horsemint, croton, and sunflower will dominate. The potential production per acre when the range is in excellent condition is 4,000 pounds, dry weight, in favorable years and 1,500 pounds in unfavorable years.

This soil is poorly suited to pasture. Low available water capacity and low fertility are the main limitations. Fertilization, controlled grazing, and weed control are needed to maintain productivity. Suitable grasses are Coastal bermudagrass, weeping lovegrass, and switchgrass.

This soil is poorly suited to crops. The severe hazard of soil blowing and low available water capacity are the main limitations.

This soil is well suited to most urban and recreation uses. The sandy texture is a limitation for some of those uses.

This soil is in capability subclass VIIe and the Sand Hill range site.

GaB—Galveston fine sand, gently undulating. This soil is on low ridges in the eastern part of the county, near the bay. Slopes are 1 to 5 percent. Areas are irregular and range from about 10 to 2,600 acres.

Typically, the surface layer is light brownish gray fine sand about 30 inches thick. Below that, from 30 to 48 inches, is pale brown fine sand. The underlying material to a depth of 65 inches is very pale brown fine sand with a few fine yellowish brown mottles. The soil is moderately alkaline throughout.

This deep soil is somewhat excessively drained. It is rarely flooded. Surface runoff is none to slow. Permeability is rapid. Available water capacity is low. The hazard of soil blowing is severe, and the hazard of water erosion is slight. A seasonal water table is 3 to 6 feet below the surface.

Included in mapping are areas, in depressions, of Mustang and Saucel soils. Also included are small areas of Falfurrias and Yturria soils. The included soils make up less than 25 percent of any one mapped area.

This soil is used mostly as rangeland and wildlife habitat.

In rangeland, low fertility and low available water capacity are the main limitations. Proper management that includes controlled grazing is needed to maintain productivity.

The potential plant community is open grassland with a few shrubs. The dominant grasses are seacoast bluestem, switchgrass, marshhay cordgrass, and gulfdune paspalum. Brownseed paspalum, threeawn, and

meadow dropseed increase under heavy grazing. Among the major plants are greenbrier, American snoutbean, and millpea and annual forbs. If heavy grazing occurs for many years, threeawn, sandbur, and annual weeds will dominate. The potential production per acre when the range is in excellent condition is 4,500 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

This soil is moderately well suited to pasture grasses. Low available water capacity and low fertility are the main limitations. Proper management that includes fertilization, controlled grazing, and weed control is needed to maintain productivity. Suitable grasses are Coastal bermudagrass, weeping lovegrass, and switchgrass.

This soil is not suited to crops. The severe hazard of soil blowing is the main limitation.

This soil is not suited to most urban and recreation uses because of the hazard of flooding. For some uses, the sandy texture is a limitation.

This soil is in capability subclass VIe and the Coastal Sand range site.

GdB—Galveston-Dune land complex, gently undulating. This map unit consists of hummocky and duned ridges on the gulf side of Padre Island. The surface is convex. Slope is mostly 1 to 5 percent but ranges up to 30 percent. The ridges are 7 to 15 feet high. Areas are irregularly oblong and range from 40 to 300 acres.

Galveston fine sand, which is mainly on the highs and leeward sides of sand ridges, makes up about 50 percent of the complex. Active dunes, on the lower and the sea side of ridges, make up about 45 percent. Other soils, mainly Mustang and Tatton soils, make up the rest. These soils are so intricately mixed that it is not practical to separate them at the scale mapped.

Typically, the Galveston soil has a surface layer of light brownish gray fine sand about 6 inches thick. The underlying material to a depth of more than 60 inches is light gray fine sand. This soil is moderately alkaline throughout.

This soil is deep and somewhat excessively drained. Surface runoff is none to slow. Flooding is a rare hazard. Permeability is very rapid. Available water capacity is low. The hazard of soil blowing is severe, and the hazard of water erosion is slight.

Dune land consists of alkaline, light gray fine sand more than 60 inches thick.

The dunes are deep and excessively drained. Surface runoff is none to slow. Permeability is rapid. Available water capacity is very low. Sand blowing is severe during strong winds.

In rangeland, on the Galveston soil, limited seasonal grazing is needed to prevent the removal of the thin grass cover. No vegetation grows on Dune land.

The potential plant community on the Galveston soil is open grassland and a few shrubs. The dominant grasses are seacoast bluestem, switchgrass, and gulfdune paspalum. Brownseed paspalum, meadow dropseed, and threeawn increase under heavy grazing. Other major plants are greenbrier, American snoutbean, and crotons and annual forbs. If heavy grazing is prolonged, threeawn, sandbur, and annual weeds will dominate. The potential production per acre when the range is in excellent condition is 3,500 pounds, dry weight, in favorable years and 1,500 pounds in unfavorable years.

The soils in this complex are not suited to pasture or crops. The severe hazard of soil blowing, low fertility, and low or very low available water capacity are the main limitations.

The soils in the complex are not suited to most urban and recreation uses. The slope, sandy texture, flood hazard, severe hazard of soil blowing, and rapid permeability are the main limitations.

This complex is in capability subclass VIIe. The Galveston soil is in the Coastal Sand range site.

GmB—Galveston-Mustang complex, gently undulating. This complex consists of deep soils on low coastal terraces and on Padre Island. The areas were once severely eroded and have been revegetated. The surface is mainly gently undulating, consisting of nearly level and hummocky areas. Slopes are 0 to 20 percent. Areas are broad and irregular and range from about 100 to more than 4,000 acres.

Galveston fine sand, which is in hummocky areas, makes up about 50 percent of the complex. Mustang fine sand, in nearly level depressions, makes up 45 percent. Sand dunes and other sandy soils make up the remaining 5 percent. These soils are so intricately mixed that it is not practical to map them separately at the scale used.

Typically, the Galveston soil has a surface layer of pale brown fine sand about 8 inches thick. The underlying material to a depth of 60 inches is very pale brown fine sand. The soil is moderately alkaline throughout.

This soil is somewhat excessively drained. It is rarely flooded. Surface runoff is none to slow. Permeability is rapid. Available water capacity is low. The hazard of soil blowing is severe, and the hazard of water erosion is slight. A water table is at a depth of 3 to 6 feet in most years.

Typically, the Mustang soil has a surface layer of pale brown fine sand about 8 inches thick. From 8 to 20 inches is very pale brown fine sand that has a few faint, dark yellowish brown mottles. The underlying material to a depth of 60 inches is very pale brown fine sand that has many yellowish brown mottles. The soil is mildly alkaline throughout.

This soil is poorly drained and has very low available water capacity. Runoff is very slow or ponded.

Permeability is rapid. The water table is 0 to 1.5 feet below the surface during wet periods. Ponding after heavy rains is common. The hazard of soil blowing is severe.

The soils of this complex are used as rangeland and wildlife habitat. They are not suited to crops. For cropland, soil blowing, low fertility, and low available water capacity are the main limitations. For rangeland, controlled grazing and maintaining a grass cover to prevent sand blowing are needed to maintain productivity.

On the Galveston soil the potential plant community is open grassland covered with a few shrubs. The dominant grasses are seacoast bluestem, switchgrass, and gulfdune paspalum. Brownseed paspalum, sea-oats, big reedgrass, and meadow dropseed increase under heavy grazing. Other major plants are greenbrier, American snoutbean, croton, and annual forbs. The potential production per acre when the range is in excellent condition is 3,500 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

On the Mustang soil the potential plant community is open grassland. The better major grasses are seacoast bluestem, marshhay cordgrass, and gulfdune paspalum. Shoregrass, seashore saltgrass, and red lovegrass increase under grazing systems commonly used in the area. Other major plants are greenbrier, American snoutbean, sedges, and annual forbs. If heavy grazing occurs for many years, red lovegrass, sedges, and seashore saltgrass will dominate. The potential production per acre when the range is in excellent condition is 4,000 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

These soils are moderately well suited to pasture. The hazard of soil blowing, low fertility, and low tolerance of pasture plants to droughtiness are the main limitations. Proper management that includes fertilization, controlled grazing, and weed control is needed to maintain productivity. Suitable grasses are Coastal bermudagrass and weeping lovegrass.

These soils are not suited to most urban and recreation uses. Slope, sandy texture, wetness, and the flood hazard are the main limitations.

This complex is in capability subclass VIe. The Galveston soil is in the Coastal Sand range site. The Mustang soil is in the Low Coastal Sand range site.

HaA—Hargill fine sandy loam, 0 to 1 percent slopes. This deep, nearly level soil is on low ridges of high stream terraces in the western part of the county. The surface is plane to convex. Areas are round and range from 10 to 200 acres.

Typically, the surface layer is neutral fine sandy loam about 14 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The upper part of the subsoil, from 14 to 34 inches, is neutral to moderately alkaline, dark brown sandy clay loam. The middle part of the subsoil, extending from 34 to 42 inches, is moderately alkaline, brown sandy clay loam. The lower part of the subsoil from 42 to 65 inches is moderately alkaline, reddish yellow sandy clay loam that has many masses and concretions of calcium carbonate.

This soil is well drained. Surface runoff is slow or medium. Permeability is moderate. Available water capacity is moderate. The hazard of soil blowing is moderate. The hazard of water erosion is slight.

Included in mapping are small areas of Delfina, Willacy, and Racombes soils. These included soils make up less than 15 percent of any one mapped area.

This soil is used mostly for crops, dominantly irrigated citrus, and it is well suited to use as cropland. Suitable nonirrigated crops are cotton and grain sorghum, and suitable irrigated crops are sugarcane and many kinds of vegetables. During dry periods, a lack of soil moisture in nonirrigated areas can limit yields. Cropping systems that include crops that produce large amounts of residue are needed to maintain soil tilth. Tile drains can be used to lower the seasonal high water table in irrigated areas. Bedding the land and proper use of crop residue when the soil is fallowed help to reduce soil blowing, which can be severe when the soil is loose and dry.

This soil is well suited to pasture. Proper management that includes fertilization, rotation grazing, and weed control are needed to maintain productivity. Suitable grasses are Coastal bermudagrass, buffelgrass, and introduced bluestems.

In some areas, the soil is used as rangeland. In rangeland, controlled grazing and proper stocking are needed to maintain productivity. The potential plant community is mid grasses and some forbs and woody plants. The better grasses are fourflower trichloris, plains bristlegrass, Arizona cottontop, and silver bluestem. Hooded windmillgrass, fall witchgrass, and threeawn increase in heavily grazed areas. The major forbs and woody plants are Engelmann-daisy, sensitivebriar, spiny hackberry, mesquite, and pricklypear. If heavy grazing is prolonged for many years, thorny brush will dominate. The potential production per acre when the range is in excellent condition is 5,500 pounds, dry weight, in favorable years and 2,200 pounds in unfavorable years.

This soil is well suited to urban and recreation uses.

This soil is in capability subclass IIc, nonirrigated, and class I, irrigated. It is in the Sandy Loam range site.

HaB—Hargill fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping soil is on ridges of high stream terraces in the western part of the county. The surface is convex. Areas are rounded and range from 20 to 100 acres.

Typically, the surface layer is neutral, grayish brown fine sandy loam about 15 inches thick. The upper part of the subsoil, from 15 to 34 inches, is neutral sandy clay loam that grades from brown to reddish brown. The middle part of the subsoil, from 34 to 45 inches, is mildly

alkaline, light reddish brown sandy clay loam. The lower part of the subsoil to a depth of 62 inches is moderately alkaline, brownish yellow sandy clay loam with a few threads and films of calcium carbonate.

This soil is well drained. Surface runoff is medium. Permeability is moderate. Available water capacity is high. The erosion hazard is moderate.

Included in mapping are small areas of Willacy and Delfina soils and a few small areas of Hargill fine sandy loam that has slope of 3 to 5 percent. These included soils make up less than 15 percent of any one mapped area.

This soil is used mostly as cropland, for which it is well suited. Suitable nonirrigated crops are cotton and grain sorghum, and suitable irrigated crops are sugarcane and a variety of vegetables. This soil is well suited to irrigated citrus.

To maintain soil tilth, cropping systems that produce large amounts of residue are needed. In irrigated areas, tile drains can be used to lower the seasonal high water table. Bedding the soil and proper use of crop residue when fallowing help to prevent soil blowing. Farming on the contour or across the grade helps to prevent water erosion.

This soil is well suited to pasture. Controlled grazing, fertilization, rotational grazing, and weed control are needed to maintain productivity. The suitable grasses are Coastal bermudagrass, buffelgrass, and introduced bluestems.

In rangeland, management that includes rotational grazing and proper stocking is needed. The potential plant community is mid grasses and some forbs and woody plants. The dominant grasses are fourflower trichloris, plains bristlegrass, Arizona cottontop, and silver bluestem. Hooded windmillgrass, fall witchgrass, and threeawn increase under heavy grazing. The major forbs and woody plants are Engelmann-daisy, sensitivebriar, spiny hackberry, mesquite, and pricklypear. If heavy grazing occurs for many years, thorny brush will dominate. The potential production per acre when the range is in excellent condition is 5,500 pounds, dry weight, in favorable years and 2,200 pounds in unfavorable years.

This soil is well suited to most urban and recreation uses.

This soil is in capability subclass IIe, nonirrigated or irrigated. It is in the Sandy Loam range site.

HgB—Hidalgo fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping soil is on high stream terraces. The surface is convex. Areas are round to oblong and range from 20 to 100 acres.

Typically, the surface layer is grayish brown fine sandy loam about 18 inches thick. The upper part of the subsoil, from 18 to 28 inches, is light brownish gray sandy clay loam with a few fine segregated masses of calcium carbonate. The lower part of the subsoil, from 28 to 36 inches, is pale brown sandy clay loam. Below that to a depth of 60 inches is very pale brown sandy clay loam with many soft calcium carbonate masses. Typically, the soil is calcareous and moderately alkaline throughout.

This soil is well drained. Surface runoff is medium. Permeability is moderate. Available water capacity is moderate. The erosion hazard is slight. This soil is easy to work and responds well to good management.

Included in mapping are small areas of Yturria and Willacy soils on the outer edge of the mapped areas, small areas of Hargill soils that have slope of 3 to 5 percent, and some areas of nearly level Hargill soils. These included soils make up less than 15 percent of any one mapped area.

This soil is used mostly for rangeland and wildlife habitat.

For rangeland, controlled grazing and maintaining a grass cover to prevent erosion are needed to maintain productivity.

The potential plant community is grassland with mesquite and some underbrush. The grasses are fourflower trichloris, silver bluestem, and plains bristlegrass. Threeawn, hooded windmillgrass, and hairy tridens increase under most grazing systems commonly used in the area. Other plants are mesquite, anacahuita, whitebrush, thorny brush, and forbs. If heavy grazing occurs for many years, brush will dominate. The potential production per acre when the range is in excellent condition is 4,500 pounds, dry weight, in favorable years and 2,500 pounds in unfavorable years.

This soil is well suited to pasture grasses. Under proper management, controlled grazing, fertilization, and weed control are needed to maintain productivity. Suitable grasses are buffelgrass and Coastal bermudagrass.

This soil is moderately well suited to crops. Suitable crops are cotton and grain sorghum. The erosion hazard is the main limitation. The high lime content causes iron chlorosis in some plants. Farming the soil on the contour helps to reduce water erosion. Bedding the land during the fallow period helps to reduce soil blowing.

This soil is moderately well suited to most urban uses. The moderate shrink-swell potential is the main limitation.

The soil is well suited to most recreation uses. Slope is a limitation for some of those uses.

This soil is in capability subclass IIe and the Gray Sandy Loam range site.

HoA—Hidalgo sandy clay loam, 0 to 1 percent slopes. This deep, nearly level soil is on low rises on the middle coastal terrace. The surface is plane. Areas are broad and irregular in shape and range from 40 to 200 acres.

Typically, the surface layer is grayish brown sandy clay loam about 14 inches thick. The subsoil, which extends

to a depth of 42 inches, is sandy clay loam that is brown in the upper part and pale brown in the lower part and has many threads and films of calcium carbonate. The underlying material to a depth of 60 inches is very pale brown clay loam with many soft masses of calcium carbonate. This soil is moderately alkaline throughout.

This soil is well drained. Surface runoff is slow. Permeability is moderate. Available water capacity is high. The erosion hazard is slight. The soil is easy to work and responds well to good management.

Included in mapping are small areas of Raymondville, Lyford, and Racombes soils. These soils make up less than 15 percent of any one mapped area.

The soil is used mostly for crops, including irrigated citrus, for which it is well suited. During droughts a lack of soil moisture in nonirrigated areas can reduce yields. The high lime content causes iron chlorosis in some plants. Cropping systems that include crops that produce large amounts of residue are needed to maintain soil tilth. Suitable nonirrigated crops are cotton and grain sorghum (fig. 6). In irrigated areas, suitable crops are sugarcane and many kinds of vegetables. Land leveling can help to increase the efficiency of irrigation and to conserve moisture. Surface drains can be used to remove excess water after heavy rains. Tile drains can be used to lower the seasonal high water table that can develop under irrigation.

This soil is well suited to pasture grasses. Proper management that includes fertilization, rotational grazing, and weed control is needed to maintain productivity. The suitable grasses are Coastal bermudagrass, African stargrass, and introduced bluestem.

Figure 6.—The cotton and grain sorghum in this area of Hidalgo sandy clay loam are the two major crops in the county.

In some areas, this soil is used for rangeland and wildlife habitat. Controlled grazing and proper stocking are needed to maintain rangeland productivity.

The potential plant community is grassland with mesquite and some underbrush. The grasses are twoflower trichloris, fourflower trichloris, silver bluestem, and plains bristlegrass. Threeawn, hooded windmillgrass, and tridens increase under heavy grazing. Other plants are mesquite, whitebrush, thorny brush, and forbs. If heavy grazing occurs for many years, mesquite and thorny brush will dominate. The potential production per acre when the range is in excellent condition is 4,500 pounds, dry weight, in favorable years and 2,500 pounds in unfavorable years.

This soil is moderately well suited to urban uses. The moderate shrink-swell potential is the main limitation to urban uses. The soil is well suited to recreation uses.

This soil is in capability subclass IIc, nonirrigated, and class I, irrigated. It is in the Gray Sandy Loam range site.

Ic—Incell clay. This soil is in wet depressions of the low coastal terraces. The surface is concave and ponded. Slopes are less than 1 percent. Areas are nearly round and range from 2 to 40 acres.

Typically, the surface layer is neutral, black clay about 25 inches thick. The underlying material to a depth of 60 inches is moderately alkaline, grayish brown sandy clay loam mottled with light olive brown.

This soil is very poorly drained. The permanent water table is at or near the surface. The soil is saturated or ponded with water up to 3 feet deep except during extreme dry periods. Permeability is very slow. Available water capacity is high.

Included in mapping are small areas of Jarron, Rio, and Tiocano soils. These included soils make up less than 15 percent of any one mapped area.

This soil is used mostly as rangeland and wetland wildlife habitat.

For rangeland, wetness is the main limitation. Controlled grazing and proper stocking are needed to maintain productivity.

The potential plant community is water-loving grasses and forbs. The major grasses are marshhay cordgrass, big cordgrass, gulf cordgrass, and paspalums. Other plants are sedges, rushes, cattails, waterhyacinth, waterlilies, and waterweeds. The potential production per acre when the range is in excellent condition is 7,000 pounds, dry weight, in favorable years and 4,000 pounds in unfavorable years.

This soil is not suited to crops or pasture. It is limited mainly by wetness and ponding. It is not feasible to drain most areas of this soil.

This soil is not suited to urban and recreation uses. Ponding and wetness are the main limitations to those uses.

This soil is in capability subclass VIw and the Marsh range site.

Ja—Jarron sandy clay loam. This soil is in depressions of the low coastal terraces. The surface is concave and frequently ponded. Slopes are less than 1 percent. Areas are round to oblong and range from 10 to 160 acres.

Typically, the surface layer is neutral, dark gray sandy clay loam about 7 inches thick. The next layer, from 7 to 8 inches, is neutral, gray fine sandy loam. The subsoil from 8 to 26 inches is saline, gray sandy clay that is neutral in the upper part and mildly alkaline in the lower part. The lower part of the subsoil, from 26 to 36 inches, is saline, moderately alkaline, grayish brown clay loam with a few calcium carbonate and black concretions, probably iron and manganese. The underlying material to a depth of 65 inches is saline, moderately alkaline, very pale brown clay loam with many concretions of calcium carbonate.

This soil is poorly drained and sodic. It is saturated or ponded a few weeks during fall and spring unless surface drainage is provided. Permeability is slow. Available water capacity is moderate. The erosion hazard is slight.

Included in mapping are small areas of Rio, Racombes, Tiocano, and Willamar soils. The included soils make up less than 15 percent of any one mapped area.

This soil is used mostly as rangeland and wildlife habitat.

In rangeland, controlled grazing and proper stocking are needed to maintain productivity. The potential plant community consists of grassland. The plants can tolerate varying degrees of wetness. The better grasses are hartweg paspalum, spike lovegrass, and switchgrass. Sedges, rushes, sesbania, and huisache increase under most grazing systems commonly used in the area. If heavy grazing occurs for many years, huisache and forbs will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 2,500 pounds in unfavorable years.

This soil is moderately well suited to pasture grasses. Wetness, sodicity, and salinity are the main limitations. Proper management that includes fertilization and rotational grazing are needed to maintain productivity. Suitable grasses are Coastal bermudagrass and African stargrass.

This soil is poorly suited to crops. It is limited mainly by ponding and wetness. Surface drainage is needed before cropping is feasible. Suitable crops in drained areas are cotton and grain sorghum.

This soil is not suited to urban uses, and it is poorly suited to most recreation uses. Ponding and wetness are the main limitations for those uses.

This soil is in capability subclass IVw, nonirrigated, and IIIs, drained. It is in the Lakebed range site.

LaB—Lalinda sandy clay loam, 1 to 5 percent slopes. This gently sloping soil is on low ridges on low coastal terraces. The ridges are at the highest elevation in the coastal areas, up to 25 feet above mean sea level. The surface is convex. Areas are irregularly shaped and range from 5 to 200 acres.

Typically, the surface layer is mildly alkaline sandy clay loam that is grayish brown in the upper part and gray in the lower part. The upper part of the subsoil, from 6 to 30 inches, is moderately alkaline sandy clay loam that grades from grayish brown to light brownish gray. The lower part of the subsoil, from 30 to 56 inches, is moderately alkaline, light gray sandy clay loam with a few threads and films of segregated salt and calcium carbonate. Below that to a depth of 72 inches is moderately alkaline, light gray sandy clay loam with many threads and films of segregated salt and calcium carbonate.

This soil is deep and well drained. Surface runoff is medium to rapid. Permeability is moderately slow. Available water capacity is moderate; salinity inhibits the intake of water by plants. The hazard of soil blowing is slight. The hazard of water erosion is severe.

Included in mapping are small areas of Sauz, Latina, and Saucel soils, which are mainly on the outer edge of the mapped areas. These included soils make up less than 25 percent of any one mapped area.

This soil is used mostly as rangeland and wildlife habitat.

For rangeland, controlled grazing and brush control are needed to maintain productivity.

The potential plant community is grasses, shrubs, and forbs. The dominant grasses are fourflower trichloris, big sacaton, Arizona cottontop, and plains bristlegrass. Hooded windmillgrass, lovegrass tridens, fall witchgrass, and buffalograss increase under heavy grazing. The major woody plants are Berlandier fiddlewood, twisted acacia, yucca, cenizo, pricklypear, mesquite, and Texas ebony. If heavy grazing occurs for many years, thorny brush will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 1,000 pounds in unfavorable years.

This soil is moderately well suited to pasture. Salinity and the hazard of water erosion are the main limitations. Controlled grazing, fertilization, and weed control are needed to maintain productivity. Suitable grasses are Coastal bermudagrass and African stargrass.

This soil is poorly suited to crops. The salinity and the hazard of water erosion are the main limitations.

This soil is moderately well suited to most urban and recreation uses. Low strength, which affects roads and streets, and slope, moderately slow permeability, and excess salts are the main limitations.

This soil is in capability subclass VIe and the Coastal Ridge range site.

Le—Latina sandy clay loam. This nearly level soil is in drainageways and slight depressions of low coastal terraces near the bay. The surface is plane to slightly concave. Slopes are less than 1 percent. Areas are irregularly shaped and range from 10 to 300 acres.

Typically, the surface layer is moderately alkaline, gray sandy clay loam about 4 inches thick. The subsoil, from 4 to 16 inches, is moderately alkaline gray sandy clay loam mottled with olive. The lower part of the subsoil, from 16 to 26 inches, is moderately alkaline, light brownish gray sandy clay loam with brownish mottles and a few masses of salt and calcium carbonate. The underlying material to a depth of 60 inches is strongly alkaline, light brownish gray sandy clay loam with brownish mottles and many calcium carbonate and salt masses. This soil is saline throughout.

This soil is somewhat poorly drained. Surface runoff is slow or very slow. Permeability is slow. Available water capacity is very low because salinity inhibits the intake of water by plants. The erosion hazard is slight. A seasonal saline water table is within 1 to 3 feet of the surface. This soil is occasionally flooded.

Included in mapping are small areas of Saucel, Lomalta, Porfirio, and Willamar soils. Local areas near the Arroyo Colorado have a clayey subsoil. These included soils make up less than 25 percent of any one mapped area.

This soil is used mostly as rangeland and wildlife habitat.

For rangeland, salinity and wetness are the main limitations. Controlled grazing is needed to maintain productivity and keep desirable plants. The potential plant community is salt-tolerant grasses and plants. The major grasses are gulf cordgrass and seashore saltgrass. The major forbs and woody plants are bushy sea-oxeye, seawort, and pickleweed saltbush. Gulf cordgrass decreases and seashore saltgrass increases in the plant community under heavy grazing. If heavy grazing occurs for many years, bushy sea-oxeye and pickleweed saltbush will dominate. The potential production per acre when the range is in excellent condition is 4,000 pounds, dry weight, in favorable years and 1,000 pounds in unfavorable years.

This soil is not suited to crops. Conversion to cropland requires major surface and subsurface drainage systems to reduce salinity and wetness.

This soil is poorly suited to pasture. The salinity and wetness are the main limitations. To make pastures productive, drainage to reduce salinity and wetness is needed. Suitable salt-tolerant grasses are Coastal bermudagrass and African stargrass.

This soil is not suited to urban uses and most recreation uses. Flooding, wetness, excess salt, and excess sodium are the main limitations to those uses.

This soil is in capability subclass VIs and the Salt Flat range site.

Lm—Lomalta clay. This soil is in depressions along the Arroyo Colorado and on the low coastal terraces. The surface is concave and is frequently ponded. Slopes are less than 1 percent. Areas are round or oblong and range from 5 to 200 acres.

Typically, this soil is gray clay to a depth of about 44 inches. Below that to a depth of 65 inches is light brownish gray clay containing a few salt threads. This soil is strongly saline and moderately alkaline throughout.

This soil is poorly drained. Permeability is very slow. Available water capacity is very low. The erosion hazard is slight. The soil is saturated or ponded a few weeks during fall and spring unless the surface is drained. A seasonal saline water table is at a depth of 4 to 6 feet.

Included in mapping are small areas of Latina and Tiocano soils. These included soils make up less than 15 percent of any one mapped area.

This soil is used mostly as rangeland and wildlife habitat. Salinity and wetness are the main limitations.

In rangeland, controlled grazing and proper stocking are needed to maintain productivity.

The potential plant community is grasses and forbs. The dominant grass is gulf cordgrass. Other grasses are seashore saltgrass, shoregrass, and marshhay cordgrass. Bushy sea-oxeye and slim aster increase under most grazing systems commonly used in the area. If heavy grazing occurs for many years, bushy sea-oxeye will dominate. The potential production per acre when the range is in excellent condition is 4,500 pounds, dry weight, in favorable years and 1,500 pounds in unfavorable years.

This soil is not suited to cultivated crops. Salinity is the main limitation. Reclamation for cropland is severely limited because the clay keeps salts from leaching out.

This soil is poorly suited to pasture, mainly because of salinity and wetness. Reducing salinity and providing surface drainage are the main needs in improving pasture productivity. Suitable salt-tolerant grasses are Coastal bermudagrass and African stargrass.

This soil is not suited to most urban uses and is poorly suited to recreation uses. The high shrink-swell potential, ponding, excess salt, excess sodium, clay texture, and very slow permeability are the main limitations.

This soil is in capability subclass VIIs, nonirrigated. It is in the Salty Marsh range site.

Ln—Lozano fine sandy loam. This nearly level soil is on ridges of low coastal terraces. The surface is plane to convex. Slopes are 0 to 2 percent. Areas are irregular and range from about 10 to 2,000 acres.

Typically, the surface layer is neutral fine sandy loam about 16 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The subsoil from 16 to 24 inches is neutral, grayish brown sandy clay loam. The subsoil from 24 to 44 inches is brown sandy clay loam that is mildly alkaline in the upper part and moderately alkaline in the lower part. The underlying material to a depth of 65 inches is moderately alkaline, pink sandy clay loam and has a few threads and films of calcium carbonate.

This soil is deep and somewhat poorly drained. Surface runoff is slow. Permeability is moderately slow. Available water capacity is moderate. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. The seasonal water table is 1 to 3 feet beneath the surface.

Included in mapping are small areas of Willacy, Lyford, and Racombes soils. These included soils make up less than 25 percent of any one mapped area.

This soil is used mostly as cropland, for which it is well suited. Cropping systems that include crops that produce large amounts of residue are needed to maintain soil tilth. Suitable irrigated crops are sugarcane and a wide variety of vegetables, and suitable nonirrigated crops are cotton and grain sorghum. Tile drainage can be used to lower the seasonal high water table. Listing, or bedding, and leaving crop residue on the surface during fallow periods will prevent most of the soil blowing that occurs when the soil is loose and dry.

This soil is moderately well suited to irrigated citrus. The seasonal wetness is the main limitation. Subsurface drainage is the main need.

This soil is well suited to pasture grasses. Proper management that includes fertilization, rotational grazing, and weed control is needed to maintain productivity. Suitable grasses are Coastal bermudagrass, buffelgrass, and introduced bluestems.

This soil is used as rangeland and wildlife habitat. In rangeland, controlled grazing and proper stocking are needed to maintain productivity. The potential plant community is mid grasses with some forbs and woody plants. The dominant grasses are fourflower trichloris (fig. 7), Arizona cottontop, and plains bristlegrass. Increasers under heavy grazing are hooded windmillgrass, fall witchgrass, threeawn, and buffalograss.

Other dominant plants are mesquite, condalia, spiny hackberry, bushsunflower, and annual forbs. If heavy grazing occurs for many years, mesquite and thorny brush will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 3,000 pounds in unfavorable years.

This soil is moderately well suited to most urban and recreation uses. Seasonal wetness is the main limitation.

This soil is in capability subclass IIw, nonirrigated or irrigated. It is in the Tight Sandy Loam range site.

Ly—Lyford sandy clay loam. This nearly level soil is on drainageways of the low coastal terraces. The

Figure 7.—This area of Lozano fine sandy loam in the Tight Sandy Loam range site is in excellent condition. The major grass is fourflower trichloris.

surface is plane. Slopes are less than 1 percent. Areas are irregularly shaped and range from 10 to 100 acres.

Typically, the surface layer is neutral, dark grayish brown sandy clay loam about 12 inches thick. The subsoil, from 12 to 40 inches, is sandy clay loam that is mildly alkaline and dark grayish brown in the upper part and moderately alkaline and brown in the lower part. The underlying material to a depth of 60 inches is moderately alkaline, light brown clay loam, which has many soft masses and concretions of calcium carbonate.

This soil is deep and moderately well drained. Surface runoff is slow. Permeability is moderate. Available water capacity is high. The erosion hazard is slight. A seasonal high water table is within 3 to 5 feet of the soil surface.

Included in mapping are small areas of Raymondville, Lozano, and Willamar soils. These soils make up less than 15 percent of any one mapped area.

This soil is used mostly as cropland, for which it is well suited. Cropping systems that include crops that produce large amounts of residue are needed to maintain soil tilth. Suitable nonirrigated crops are cotton and grain

sorghum, and suitable irrigated crops are sugarcane and a wide variety of vegetables. Land leveling can help increase the efficiency of irrigation and conserve moisture. Tile drains can be used to lower the seasonal high water table. Surface drains are useful in removing excess water after heavy rains.

This soil is moderately well suited to irrigated citrus. Seasonal wetness is the main limitation. Surface and subsurface drainage are the main needs.

This soil is well suited to pasture. Fertilization, controlled grazing, and weed control are needed to maintain productivity. Suitable grasses are Coastal bermudagrass, African stargrass, and introduced bluestems.

In some areas, this soil is used as rangeland and wildlife habitat.

In rangeland, controlled grazing and proper stocking are needed to maintain productivity. The potential plant community is grassland with some mesquite trees and woody shrubs. Among the better grasses are fourflower trichloris, silver bluestem, pappusgrass, and African cottontop. Buffalograss, curlymesquite, hooded windmillgrass, and threeawn increase under most grazing systems commonly used in the area. Other plants are mesquite, whitebrush, and a variety of thorny brush. If heavy grazing occurs for many years, mesquite and thorny brush will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 3,000 pounds in unfavorable years.

This soil is moderately well suited to most urban and recreation uses. The moderate shrink-swell potential and seasonal wetness are the main limitations.

This soil is in capability subclass IIw, nonirrigated or irrigated. It is in the Clay Loam range site.

Me—Mercedes clay. This soil is on slightly depressed flats of the middle stream terraces. The surface is plane to slightly concave. Slopes are less than 0.5 percent. Areas are irregular and round to oblong and range from 10 to 1,500 acres.

Typically, this soil is moderately alkaline, gray clay in the upper 48 inches. Below that to 80 inches is strongly alkaline clay that is grayish in the upper part and brownish in the lower part. This soil is calcareous throughout. Slickensides occur below a depth of 12 inches.

Mercedes clay is deep and moderately well drained. Surface runoff is very slow. Permeability is very slow. Available water capacity is moderate. The erosion hazard is slight. Surface water is common for a few days after heavy rains unless the soil is provided with surface drainage.

Included in mapping are small areas of Raymondville and Tiocano soils. These included soils make up less than 15 percent of any one mapped area.

This soil is used mostly for crops, for which it is moderately well suited. The clay texture and very slow permeability are the main limitations for cropland use.

Cropping systems that include crops that produce a large amount of residue are needed to improve soil structure and maintain tilth. Crops suited to nonirrigated areas are cotton and grain sorghum, and those suited to irrigated areas are a wide variety of vegetables. This soil is poorly suited to irrigated citrus and sugarcane because it is very slowly permeable. Land leveling can help to increase the efficiency of irrigation. Surface drainage is useful in removing excess water after heavy rains.

This soil is well suited to pasture grasses. Proper management that includes fertilization, rotational grazing, and weed control is needed to maintain productivity. The suitable grasses are Coastal bermudagrass, African stargrass, and introduced bluestems.

In some areas, this soil is used as rangeland and wildlife habitat. In rangeland, controlled grazing and proper stocking are needed to maintain productivity.

The potential plant community is grasses and sparsely scattered mesquite. The better grasses are twoflower trichloris, pappusgrass, white tridens, and vine-mesquite. Spike lovegrass, sacaton, buffalograss, and perennial threeawn increase under most grazing systems commonly used in the area. If heavy grazing occurs for many years, spike lovegrass will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

This soil is poorly suited to most urban and recreation uses. The clayey texture, the high shrink-swell potential, and the very slow permeability are the main limitations.

This soil is in capability subclass IIIs, nonirrigated or irrigated. It is in the Clay Flat range site.

Mp—Mercedes clay, ponded. This soil is in depressions of the middle stream terraces. It is frequently ponded. Slopes are less than 1 percent. Areas are roundish or oblong and range from about 5 to 830 acres.

Typically, the surface layer is moderately alkaline, gray clay about 55 inches thick. The underlying material to a depth of 65 inches is strongly alkaline, light brownish gray clay with a few salt threads. This soil is saline and calcareous throughout.

This soil is moderately well drained. Permeability is very slow. Available water capacity is low. The erosion hazard is slight. The soil is saturated or ponded a few weeks during fall and spring unless surface drainage is provided.

Included in mapping are small areas of Lomalta, Jarron, Latina, and Tiocano soils. These included soils make up less than 15 percent of any one mapped area.

This Mercedes soil is used mostly as rangeland and wildlife habitat.

In rangeland, ponding is the main limitation. Proper management that includes controlled grazing is needed to maintain productivity.

The potential plant community is grasses with sparsely scattered mesquite. The major better grasses are twoflower trichloris, pappusgrass, white tridens, and vine-mesquite. Spike lovegrass, sacaton, buffalograss, and perennial threeawn increase under most grazing systems commonly used in the area. Other plants are mesquite, whitebrush, and huisache. If heavy grazing occurs for many years, spike lovegrass will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 2,500 pounds in unfavorable years.

This Mercedes soil is moderately well suited to pasture. Proper management that includes fertilization and drainage is needed to maintain productivity. Suitable grasses are Coastal bermudagrass and African stargrass.

This soil is poorly suited to crops. Ponding is the main limitation, and surface drainage is the main need. In drained areas, suitable crops are cotton and grain sorghum.

This soil is not suited to urban uses and is poorly suited to most recreation uses. Ponding is the main limitation. The high shrink-swell potential, excess salt and sodium, clay texture, and very slow permeability are additional limitations.

This soil is in capability unit IVw, nonirrigated, and IIIs, drained. It is in the Lakebed range site.

Mu—Mustang fine sand. This nearly level soil is on the leeward side of coastal dunes on Padre Island and on low coastal terraces next to the bay. Slope is mainly less than 1 percent, but on low mounds, it ranges up to 3 percent. Areas are irregularly oblong and range from 40 to 400 acres.

Typically, the surface layer is moderately alkaline, light brownish gray fine sand about 8 inches thick. The underlying material to a depth of 60 inches is moderately alkaline, light gray fine sand with light olive brown mottles.

This soil is deep and poorly drained. Runoff is very slow. Permeability is rapid. Available water capacity is very low. The seasonal water table is 0 to 1.5 feet beneath the surface during wet periods. Flooding and standing water in depressions for a few days after heavy rains are common. The hazard of soil blowing is severe.

Included in mapping are small areas of Galveston soils on hummocks and Saucel and Arrada soils in saline depressions. These included soils make up less than 25 percent of any one mapped area.

This soil is used mostly as rangeland and wildlife habitat. Most areas on Padre Island are idle, but future plans are for wildlife habitat and recreation uses.

In rangeland, the hazard of soil blowing and low fertility are the main limitations. Proper stocking and controlled grazing are needed to maintain productivity.

The potential plant community is open grassland. The better grasses are seacoast bluestem, marshhay cordgrass, and gulfdune paspalum. Shoregrass, seashore saltgrass, and red lovegrass increase under grazing systems commonly used in the area. Other major plants are greenbrier, American snoutbean, sedges, and annual forbs. If heavy grazing occurs for many years, red lovegrass, sedges, and seashore saltgrass will dominate. The potential production per acre when the range is in excellent condition is 4,000 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

This Mustang soil is poorly suited to pasture. Low fertility and the hazard of soil blowing are the main limitations. Proper management that includes fertilization and weed control is needed to maintain productivity. A suitable grass is Coastal bermudagrass.

This soil is not suited to crops. Wetness, low fertility, and a severe hazard of soil blowing are the main limitations.

This soil is not suited to most urban and recreation uses. Wetness, seepage, the flood hazard, and sandy texture are the main limitations. A vegetative cover to prevent sand blowing and drainage systems are the major needs.

This soil is in capability subclass VIw and the Low Coastal Sand range site.

Nu—Nueces fine sand. This nearly level soil is on the eolian sand sheet. The surface is slightly undulating. Slopes range from 0 to 3 percent. Areas are broad and range from 100 to 1,000 acres.

Typically, the surface layer is neutral fine sand about 29 inches thick. It is light brownish gray in the upper part and very pale brown in the lower part. The upper part of the subsoil, which extends from 29 to 32 inches, is neutral, grayish brown fine sandy loam. The middle part of the subsoil, from 32 to 48 inches, is mildly alkaline grayish sandy clay loam. The lower part of the subsoil to a depth of 76 inches is moderately alkaline, yellow sandy clay loam that is mottled with yellowish brown and has a few durinodes and films of calcium carbonate and salt in the lower part.

This soil is deep and moderately well drained. Surface runoff is very slow. Permeability is moderately slow. The water intake rate is rapid. Available water capacity is moderate. The hazard of soil blowing is severe. The hazard of water erosion is slight. A perched water table commonly occurs on top of the subsoil for a few hours after heavy rains because the subsoil has slower permeability than the surface layer.

Included in mapping are small areas of Sarita and Yturria soil on small mounds, and Delfina and Sauz soils in slight depressions. These included soils make up less than 15 percent of any one mapped area.

This soil is used mostly for rangeland and wildlife habitat.

In rangeland, brush and weed control, controlled grazing, and proper stocking are needed to maintain productivity.

The potential plant community is a savannah of tall grasses and scattered mesquite. The better grasses are seacoast bluestem, crinkleawn, tanglehead, balsamscale, and switchgrass. The plant community consists also of annual and perennial forbs, such as western indigo, sensitivebrier, snoutbean, croton, and showy partridge. Under heavy grazing the better grasses are replaced mainly by knotroot bristlegrass, perennial threeawn, and hooded windmillgrass. If heavy grazing occurs for many years, woody vegetation will increase and low-quality plants such as red lovegrass, sandbur, crabgrass, snakecotton, horsemint, and croton will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

This soil is moderately well suited to pasture grasses. Droughtiness is the main limitation. Fertilization, rotational grazing, and weed control are needed tc maintain productivity. Suitable grasses are Coastal bermudagrass and weeping lovegrass.

This soil is poorly suited to crops. The severe hazard of soil blowing is the main limitation.

This soil is well suited to most urban uses. It is moderately well suited to most recreation uses. The sandy texture is the main limitation to urban uses.

This soil is in capability subclass IVe, nonirrigated or irrigated. It is in the Sandy range site.

Po—Porfirio sandy clay loam. This soil is on flats of the lower coastal terrace. The surface is plane and nearly level. Slopes are less than 1 percent. Areas are irregularly shaped and range from 10 to 4,000 acres.

Typically, the surface layer is moderately alkaline, dark gray sandy clay loam about 12 inches thick. The subsoil, which extends to a depth of 36 inches, is moderately alkaline, light brownish gray clay loam mottled with yellowish brown. The underlying material to a depth of 65 inches is strongly alkaline clay loam that is pale brown in the upper part and pinkish gray in the lower part. It has many concretions of calcium carbonate and salt. The soil is saline and calcareous throughout.

This soil is somewhat poorly drained. Surface runoff is slow. Permeability is slow. Available water capacity is moderate. The erosion hazard is slight. A seasonal saline water table occurs within 3 feet of the surface for one or more months in most years. This soil is occasionally flooded for short periods after exceptionally heavy rainfall.

Included in mapping are small areas of Raymondville, Racombes, Lyford, and Latina soils. These included soils make up less than 25 percent of any one mapped area.

This soil is used mostly for rangeland and wildlife habitat.

In rangeland, salinity and wetness are the main limitations. Controlled grazing and proper stocking are needed to maintain productivity.

The potential plant community is an open grassland that is dominated by gulf cordgrass. Among the grasses are sacaton, hartwig paspalum, seashore saltgrass, and marshhay cordgrass. Other plants are bushy sea-oxeye, pickleweed, and mesquite. If heavy grazing occurs for many years, bushy sea-oxeye will dominate. The potential production per acre when the range is in excellent condition is 7,000 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

This soil is well suited to pasture grasses. Proper management that includes fertilization, rotational grazing, and weed control is needed to maintain productivity. Suitable grasses are Coastal bermudagrass, African stargrass, and introduced bluestems.

This soil is moderately well suited to crops. The moderate salinity is the main limitation. Crops that produce large amounts of residue are needed to improve and maintain soil tilth. Suitable crops are cotton and grain sorghum. Surface drainage is useful in removing excess water after heavy rains. Subsurface drainage is useful in lowering the seasonal water table and in reducing salinity.

This soil is not suited to most urban and recreation uses. The shrink-swell potential, flood hazard, excess salt, and wetness are the main limitations.

This soil is in capability subclass IVs, nonirrigated, and IIIs, drained. It is in the Salty Prairie range site.

Ra—Racombes sandy clay loam. This nearly level soil is in drainageways of the middle stream terraces. The soil has plane to slightly concave slopes of less than 1 percent. Areas are irregularly rounded and range from 10 to 100 acres.

Typically, the surface layer is mildly alkaline, dark gray sandy clay loam about 10 inches thick. The subsoil to a depth of 32 inches is mildly alkaline sandy clay loam that is dark gray in the upper part and dark grayish brown in the lower part. The lower part of the subsoil, from 32 to 44 inches, is moderately alkaline, brown clay loam. Below that to a depth of 60 inches is moderately alkaline, pink clay loam with many masses of calcium carbonate.

This soil is deep and moderately well drained. It is rarely flooded. Surface runoff is slow. Permeability is moderate. Available water capacity is high. The soil is usually ponded for short periods after heavy rains unless surface drainage is provided in these areas. The erosion hazard is slight.

Included in mapping are small areas of Raymondville and Willamar soils. These included soils make up less than 15 percent of any one mapped area.

In most areas, this soil is used as cropland. In a few areas, it is used as rangeland, pastureland, orchards, and urban and built-up land.

This soil is well suited to crops. Cropping systems that include crops that produce much residue are needed to maintain soil tilth. Suitable crops in nonirrigated areas are cotton and grain sorghum. In irrigated areas, suitable crops are sugarcane and vegetables. Land leveling can help increase the efficiency of irrigation and conserve moisture. Surface drainage can help to remove excess water after heavy rains. Subsurface drains can be used to lower the seasonal high water table and to prevent salinity build-up under irrigation.

This soil is moderately well suited to irrigated citrus. The seasonal wetness is the main limitation. Surface and subsurface drainage are needed to reduce wetness.

This soil is well suited to pasture. Proper management that includes fertilization, controlled grazing, and weed control is needed to maintain productivity. Suitable grasses are Coastal bermudagrass, African stargrass, and introduced bluestems.

In some areas, this soil is used as rangeland and wildlife habitat.

In rangeland, controlled grazing, proper stocking, and brush control are needed to maintain productivity. The potential plant community is open grassland and some mesquite trees and woody shrubs. The better grasses are fourflower trichloris, silver bluestem, pappusgrass, and Arizona cottontop. Buffalograss, curlymesquite, hooded windmillgrass, and threeawns increase under most grazing systems commonly used in the area. Other plants are mesquite, whitebrush, and a variety of thorny brush. If heavy grazing occurs for many years, mesquite and thorny brush will dominate. The potential production per acre when the range is in excellent condition is 6,000 pounds, dry weight, in favorable years and 2,500 pounds in unfavorable years.

This soil is not suited to most urban and recreation uses. Flooding is the main limitation. The moderate shrink-swell potential and seasonal wetness are the main limitations.

This soil is in capability subclass IIw, nonirrigated or irrigated. It is in the Clay Loam range site.

Rc—Racombes sandy clay loam, saline. This nearly level soil is in drainageways of the middle stream terraces. The surface is plane to slightly concave. Slopes are less than 1 percent. Areas are irregularly rounded and range from 10 to 100 acres.

Typically, the surface layer is saline, mildly alkaline, dark gray sandy clay loam about 10 inches thick. The subsoil to a depth of 23 inches is mildly alkaline, dark gray sandy clay loam. From 22 to 34 inches, it is saline, mildly alkaline, dark grayish brown sandy clay loam with a few brownish mottles. From 34 to 60 inches, the subsoil is saline, moderately alkaline, light brown sandy clay loam with strong brown mottles and many masses of calcium carbonate in the lower part.

This soil is deep and moderately well drained. Surface runoff is slow. Permeability is moderate. Available water capacity is low because the salinity inhibits the intake of water by plants. The soil is moderately to strongly saline because of irrigation, or restricted surface drainage, and the evaporation of saline water. A water table is generally at a depth of 1.5 to 4 feet in fall and spring. The erosion hazard is slight.

Included in mapping are small saline areas of Raymondville, Lyford, and Willamar soils, which make up less than 15 percent of a mapped area.

In most areas, this soil is used as cropland In a few areas, it is in pasture.

This soil is poorly suited to crops. Salinity and wetness are the main limitations. The soil can be improved by providing drainage to reduce soil salinity. A suitable salt-tolerant crop is cotton.

This soil is moderately well suited to pasture. Salinity is the main limitation. Proper management that includes fertilization, rotational grazing, and weed control are needed to maintain productivity. Suitable salt-tolerant grasses are Coastal bermudagrass and African stargrass.

This soil is not suited to most urban and recreation uses. Wetness and salinity are the main limitations.

This soil is in capability subclass IVs, nonirrigated or irrigated. No range site has been assigned to this map unit.

Rd—Raymondville clay loam. This deep, nearly level soil is on slightly depressed flats of the middle stream terraces. The surface is plane to slightly concave, and slopes are less than 1 percent. Areas are broad and irregular and range from 10 to more than 600 acres.

Typically, the surface layer is grayish brown clay loam about 16 inches thick. The subsoil, from 16 to 46 inches, is light brownish gray clay loam with many concretions of calcium carbonate. The underlying material to a depth of 60 inches is very pale brown clay loam. It has a few concretions of salt and calcium carbonate. The soil is moderately alkaline and calcareous throughout.

This soil is moderately well drained. Surface runoff is slow. Permeability is slow. Available water capacity is moderate. The erosion hazard is slight. Surface water is common for a few days after heavy rains unless the areas are provided with a drainage system.

Included in mapping are small areas of Mercedes clay in slight depressions and Hidalgo sandy clay loam on slight ridges. Also included are small areas of Willacy, Lyford, and Racombes soils, on the outer edge of most mapped areas. The included soils make up less than 15 percent of a mapped area.

This soil is used mostly as cropland, for which it is well suited. Cropping systems that include crops that produce large amounts of residue are needed to maintain soil

tilth. Suitable nonirrigated crops are cotton and grain sorghum, and suitable irrigated crops are sugarcane and a wide variety of vegetables. Land leveling can help increase the efficiency of irrigation and conserve moisture. Tile drains can be used to lower the seasonal high water table and reduce salinity. Surface drains are useful in removing excess water after heavy rains.

This soil is poorly suited to irrigated citrus. The clayey texture, slow surface runoff, and moderately slow permeability are the main limitations.

This soil is well suited to pasture grasses. Proper management that includes fertilization, rotational grazing, and weed control are needed to maintain productivity. Suitable grasses are Coastal bermudagrass, African stargrass, and introduced bluestems.

In rangeland, controlled grazing and proper stocking are needed to maintain productivity. The potential plant community is grassland with some mesquite trees and woody shrubs. The better grasses are fourflower trichloris, silver bluestem, pappusgrass, and Arizona cottontop. Buffalograss, curlymesquite, hooded windmillgrass, and threeawn increase under heavy grazing. Other plants are mesquite, whitebrush, and thorny brush. If heavy grazing occurs for many years, mesquite and thorny brush will dominate. The potential production per acre when the range is in excellent condition is 5,800 pounds, dry weight, in favorable years and 2,500 pounds in unfavorable years.

This soil is poorly suited to most urban and recreation uses. The shrink-swell potential and clayey surface layer are the main limitations to those uses.

This soil is in capability subclass IIs, nonirrigated or irrigated. It is in the Clay Loam range site.

Re—Raymondville clay loam, saline. This deep, nearly level soil is on flats and slight depressions of the middle stream terraces. The surface is plane to slightly concave, and slopes are less than 1 percent. Areas are oblong and range from 5 to 300 acres.

Typically, the surface layer is saline, grayish brown clay loam about 15 inches thick. The subsoil, from 15 to 38 inches, is saline, light brownish gray clay with a few films of calcium carbonate. The underlying material to a depth of 65 inches is saline, pinkish gray clay with a few masses of calcium carbonate. The soil is calcareous and moderately alkaline throughout.

This soil is moderately well drained. Surface runoff is slow. Permeability is slow. Available water capacity is low because of salinity. The erosion hazard is slight. Surface water is common for a few days after heavy rains unless the areas have a drainage system. A seasonal saline water table is 2.5 to 4.5 feet below the surface.

Included in mapping are small areas of Mercedes and Racombes soils, which make up less than 15 percent of any one mapped area.

This soil is used mostly as cropland. A few areas are in pasture.

This soil is poorly suited to crops. Salinity is the main limitation. The soil can be improved by providing drainage to reduce salinity. A suitable salt-tolerant crop is cotton.

This soil is moderately well suited to pasture. Salinity is the main limitation. Proper management that includes fertilization, rotational grazing, and weed control is needed to maintain productivity. The suitable salt-tolerant grasses are Coastal bermudagrass and African stargrass.

This soil is poorly suited to most urban and recreation uses. Salinity, high shrink-swell potential, wetness, and clayey texture are the main limitations to those uses.

This soil is in capability subclass IVs, nonirrigated or irrigated. No range site has been assigned to this unit.

Rf—Rio fine sandy loam. This nearly level soil is in depressions and drainageways on middle stream terraces. The surface is concave and occasionally ponded. Slopes are less than 1 percent. Areas are round, oval, or elongated and range from 5 to 20 acres.

Typically, the surface layer is neutral, dark gray fine sandy loam about 18 inches thick. The subsoil, from 18 to 44 inches, is sandy clay that is mildly alkaline and dark gray in the upper part and moderately alkaline and gray in the lower part. The underlying material to a depth of 60 inches is moderately alkaline, light gray sandy clay loam with light olive brown mottles and many masses of calcium carbonate.

This soil is somewhat poorly drained. Runoff is very slow or ponded. Permeability is slow. Available water capacity is high. The erosion hazard is slight. A seasonal water table is 3 to 6 feet below the surface. This soil is frequently ponded for long periods in fall.

Included in mapping are small areas of Delfina, Racombes, and other Rio soils, which have different texture in the surface layer. These included soils make up less than 15 percent of any one mapped area.

In most areas this soil is used as cropland. In a few areas it is used as pastureland and rangeland.

This soil is moderately well suited to crops. Suitable crops are cotton and grain sorghum. Slow surface and subsurface drainage are the main limitations. Improving drainage is the main need.

This soil is well suited to pasture. Proper management that includes fertilization, controlled grazing, and weed control is needed to maintain productivity. Suitable grasses, which can withstand periods of water saturation, are Coastal bermudagrass and African stargrass.

In rangeland, brush control and controlled grazing are the main needs. The potential plant community consists of grassland with plants that can tolerate varying degrees of wetness. The better grasses are hartweg paspalum, spike lovegrass, and switchgrass. Knotroot bristlegrass and common bermudagrass increase under most grazing systems commonly used in the area. Other

plants are sedges, rushes, sesbania, and huisache. If heavy grazing occurs for many years, huisache and forbs will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 2,500 pounds in unfavorable years.

This soil is not suited to urban uses, and it is poorly suited to recreation uses. Wetness and ponding are the main limitations to those uses.

This soil is in capability subclass IIIw, nonirrigated or irrigated. It is in the Lakebed range site.

Rg—Rio sandy clay loam. This soil is in circular depressions on middle stream terraces. The surface is concave. The soil is occasionally ponded. Slopes are less than 1 percent. Areas are roundish or oval and range from 5 to 40 acres.

Typically, the surface layer is neutral sandy clay loam about 10 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The upper part of the subsoil, from 10 to 26 inches, is mildly alkaline dark gray clay. The lower part of the subsoil, from 26 to 44 inches, is moderately alkaline, light brownish gray clay loam mottled with yellowish brown. The underlying material to a depth of 65 inches is moderately alkaline, light brownish gray clay loam with a few concretions of calcium carbonate.

This soil is somewhat poorly drained. Runoff is very slow to ponded. A seasonal water table is 3 to 6 feet below the surface. This soil is ponded for long periods in fall. Permeability is slow. Available water capacity is high. The erosion hazard is slight.

Included in mapping are small areas of Delfina, Racombes, and Willacy soils. These included soils make up less than 15 percent of any one mapped area.

This soil is used mainly as cropland. In a few areas, it is used as pastureland and rangeland.

In rangeland, maintaining desirable plants and controlling grazing are needed to maintain productivity. The potential plant community consists of grassland with plants that tolerate varying degrees of wetness. The better grasses are hartweg paspalum, spike lovegrass, and switchgrass. Among the major grasses are knotroot bristlegrass and common bermudagrass. Other plants are sedges, rushes, seabania, and huisache. Common bermudagrass and sedges commonly increase under heavy grazing. If heavy grazing is prolonged for many years, huisache and forbs will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 2,500 pounds in unfavorable years.

This soil is well suited to pasture. Proper management that includes fertilization, controlled grazing, and weed control is needed to maintain productivity. Suitable grasses are Coastal bermudagrass and African stargrass.

This soil is moderately well suited to most crops. Ponding is the main limitation. Surface drains are needed to remove excess water after heavy rains. Suitable crops are cotton and grain sorghum.

This soil is poorly suited to irrigated citrus. Ponding, wetness, and slow permeability are the main limitations for this crop.

This soil is not suited to most urban uses, and it is poorly suited to most recreation uses. Ponding, flooding, and clayey texture are the main limitations.

This soil is in capability subclass IIIw, nonirrigated or irrigated. It is in the Lakebed range site.

Rs—Rio sandy clay loam, saline. This nearly level soil is in depressions and drainageways on middle stream terraces. The surface is concave and occasionally ponded. Areas are round or oval and range from 5 to 30 acres.

Typically, the surface layer is saline, mildly alkaline, dark gray sandy clay loam about 16 inches thick. The upper part of the subsoil, from 16 to 36 inches, is moderately alkaline, gray clay loam. The lower part of the subsoil, from 36 to 60 inches, is saline, moderately alkaline, light brownish gray clay loam and has olive mottles and a few soft masses of salt and calcium carbonate. The underlying material to a depth of 72 inches is saline, moderately alkaline, light brownish gray clay loam with many masses of calcium carbonate.

This soil is somewhat poorly drained. Runoff is very slow or ponded. Permeability is slow. Available water capacity is low because salinity inhibits the intake of water by plants. The erosion hazard is slight. A seasonal water table is 2.5 to 4.5 feet below the surface. This soil is ponded for long periods in fall.

Included in mapping are small saline areas of Racombes, Delfina, and Tiocano soils. These included soils make up less than 15 percent of any one mapped area.

Most areas of this soil were once cropped but now are generally left idle due to salinity and wetness. A few areas have ponds for watering livestock.

This soil is poorly suited to crops. It is limited mainly by salinity and wetness. The soil can be improved by providing drainage to reduce soil salinity.

This soil is moderately well suited to pasture. Fertilization, rotational grazing, and weed control are needed to maintain productivity. The suitable salt-tolerant grasses are Coastal bermudagrass and African stargrass.

This soil is moderately well suited to wetland wildlife habitat. When the areas are ponded, mainly during winter, they are used by migrating waterfowl. The limited ponding period is the main limitation.

This soil is poorly suited to urban and recreation uses. Wetness, ponding, and excess salt are the main limitations to those uses.

This soil is in capability subclass IVs. No range site has been assigned to this unit.

SaB—Sarita fine sand, gently undulating. This deep soil is on low ridges on the eolian sand sheet. Slopes are 1 to 5 percent. The areas are irregularly shaped and range from 100 to 1,000 acres.

Typically, the surface layer is neutral, brownish fine sand about 30 inches thick. The subsurface layer, extending to a depth of 50 inches, is very pale brown, neutral fine sand. The upper part of the subsoil, from 50 to 70 inches, is light gray sandy clay loam with many brownish and reddish mottles. The lower part of the subsoil to a depth of 80 inches is very pale brown sandy clay loam with a few reddish mottles.

This soil is well drained. Runoff is slow or very slow. Permeability is moderately rapid. Available water capacity is low. The hazard of soil blowing is severe.

Included in mapping are small areas of Nueces soils, in depressions, and Falfurrias soils, on ridges. These included soils make up less than 20 percent of any one mapped area.

This soil is used as pastureland and rangeland. The soil is poorly suited to cultivated crops because of the severe hazard of soil blowing.

In rangeland, controlled grazing is needed to maintain productivity. The potential plant community is a savannah of tall grasses and scattered mesquite. The major better grasses are seacoast bluestem, crinkleawn, tanglehead, balsamscale, and switchgrass. The other major plants are annual and perennial forbs, such as western indigo, sensitivebriar, snoutbean, croton, and showy partridge. Knotroot bristlegrass, perennial threeawns, and hooded windmillgrass increase under heavy grazing. If heavy grazing occurs for many years, woody vegetation will increase and low-quality plants such as red lovegrass, sandbur, crabgrass, snakecotton, horsemint, and croton will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

This soil is moderately well suited to pasture. Low available water capacity and a severe hazard of soil blowing are the main limitations. Fertilization, rotational grazing, and weed control are needed to maintain productivity. Suitable grasses are Coastal bermudagrass and weeping lovegrass.

This soil is well suited to most urban and recreation uses. The sandy texture is a limitation for some of those uses.

This soil is in capability subclass VIe. It is in the Sandy range site.

Sf—Satatton fine sand. This nearly level soil is on low coastal terraces of Padre Island that are 1 to 3 feet above mean sea level. The surface is barren and salty. Slopes are mostly less than 1 percent. Areas are broad and extend from the bay tidal flats to the gulf beach and the length of the island in the county.

Typically, the surface layer is very pale brown fine sand about 6 inches thick. The layer from 6 to 16 inches is light gray fine sand with brownish mottles. The underlying material to a depth of 60 inches is light gray fine sand with dark gray and yellowish brown mottles. This soil is extremely saline, calcareous, and strongly alkaline throughout.

This soil is poorly drained. Surface runoff is slow. Permeability is rapid. Available water capacity is very low. The hazard of soil blowing is severe, and the hazard of water erosion is slight. A saline water table is 1 to 3 feet below the surface. During severe gulf storms, this soil is generally flooded by seawater. It is generally flooded for very brief periods after heavy rainfall.

Included in mapping are small areas of low active dunes and Tatton soils. These included soils make up less than 15 percent of any one mapped area.

This soil is not suited to crops, range, or pasture.

This soil is used mainly for recreation. Pleasure riding over the areas in sport vehicles is the main recreation use. The soil is poorly suited to wildlife habitat because it supplies no plants for food or cover. Birds use the soil at times as a resting place.

This soil is not suited to urban uses. Flooding, wetness, excess salt, excess sodium, and the sandy texture are the main limitations to those uses.

This soil is in capability subclass VIIIs. No range site has been assigned to this unit.

SgB—Satatton-Galveston complex, gently undulating. Areas of this complex are on low coastal terraces on the east side of Padre Island. They consist of nearly level flats with many widely scattered cone-shaped mounds. The soils of the flats have plane slopes of less than 1 percent. The soils of the mounds have short, convex slopes of 5 to 30 percent. Areas are irregularly oblong and range from 40 to 350 acres.

Satatton fine sand, on the nearly level flats, makes up about 50 percent of the complex. Galveston fine sand, on the mounds, makes up about 25 percent. Sand dunes and other soils make up the remaining 25 percent. These soils are so intricately mixed that it is not practical to map them separately at the scale used.

Typically, the Satatton soil has a light gray surface layer of fine sand about 18 inches thick. The underlying material to a depth of 60 inches is very pale brown fine sand. The soil is calcareous and extremely saline throughout.

This Satatton soil is poorly drained. Surface runoff is slow. Permeability is rapid above the water table. Available water capacity is very low because salinity inhibits the intake of water by plants. The hazard of soil blowing is severe, and the hazard of water erosion is slight. A saline water table is 1 foot to 3 feet below the soil surface. Flooding or ponding is frequent.

Galveston fine sand is more than 60 inches thick. Typically, the surface layer is moderately saline, pale brown fine sand about 12 inches thick. It has many roots in most places. From 12 to 40 inches is strongly saline, very pale brown fine sand, which has a few roots. Below that to a depth of 80 inches is extremely saline, very pale brown fine sand.

This Galveston soil is deep and somewhat excessively drained. Surface runoff is slow. Permeability is very rapid. Available water capacity is very low. The hazard of soil blowing is severe, and the hazard of water erosion is slight. A saline water table is 3 to 6 feet below the surface.

In most areas of this complex the soils are used for recreation and wildlife habitat. Satatton fine sand is barren of vegetation. Galveston fine sand supports halophytic vegetation, such as sea-oats, sesuvium, glasswort, saltwort, and salt heliotrope.

These soils are not suited to crops, pasture, or urban or recreation uses. Flooding, wetness, excess salts, excess sodium, the severe hazard of sand blowing, and sandy texture are the main limitations.

These soils are in capability subclass VIIIs. No range site has been assigned to this unit.

Ss—Saucel sandy loam. This nearly level soil is in drainageways of low coastal terraces near the bay. The surface is plane to slightly depressed and has slopes of less than 1 percent. Areas are irregularly long and narrow and range from 20 to 2,000 acres.

Typically, the surface layer is light brownish gray sandy loam about 4 inches thick. The subsoil to a depth of 17 inches is light gray sandy clay loam. The lower part of the subsoil, from 17 to 44 inches, is light gray sandy loam mottled with dark brown. From 44 to 52 inches, the material is gray loamy sand. The underlying material to a depth of 62 inches is light olive gray sandy clay loam mottled with light olive brown. The soil is calcareous, strongly alkaline, and extremely saline throughout.

This soil is poorly drained. Surface runoff is slow or very slow. Permeability is moderate. Available water capacity is very low because salinity inhibits the intake of water by plants. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. A saline water table is 0.5 foot to 2 feet below the surface during wet periods. This soil is occasionally flooded for brief periods after heavy rainfall.

Included in mapping are small areas of Arrada, Sauz, Satatton, and Mustang soils. These included soils are less than 15 percent of any one mapped area.

This soil is used mainly as rangeland and wildlife habitat. In rangeland, forage production is low. Salinity and wetness are the main limitations. Providing drainage will help reduce those limitations. Maintaining desirable plants and controlling grazing are needed to maintain productivity.

The potential plant community is salt-tolerant grasses and plants. The major grasses are gulf cordgrass and seashore saltgrass. The major forbs and woody plants are bushy sea-oxeye, seawort, and pickleweed saltbush. Under heavy grazing, gulf cordgrass decreases and seashore saltgrass increases. If heavy grazing occurs for many years, bushy sea-oxeye and pickleweed saltbush will dominate. The potential production per acre when the range is in excellent condition is 3,500 pounds, dry weight, in favorable years and 1,000 pounds in unfavorable years.

This soil is not suited to crops or pasture. Conversion to these uses will require the use of major drainage systems to reduce salinity and wetness.

This soil is not suited to urban uses and is poorly suited to recreation uses. Flooding, wetness, excess salt, and excess sodium are the main limitations.

This soil is in capability subclass VIIs. It is in the Salt Flat range site.

Su—Sauz fine sand. This nearly level soil is on the low coastal terraces. The surface is plane to slightly concave. Slopes are less than 1 percent. Areas are irregularly shaped and range from 40 to 1,000 acres.

Typically, the surface layer is moderately alkaline fine sand about 12 inches thick. It is light brownish gray in the upper part and pale brown in the lower part. The subsoil, to a depth of 38 inches, is moderately alkaline, light brownish gray sandy clay loam with yellowish mottles. The lower part of the subsoil, from 38 to 50 inches, is strongly alkaline, light gray sandy clay loam with reddish yellow mottles. The underlying material to a depth of 65 inches is strongly alkaline, light gray sandy clay loam with many soft and hard masses of calcium carbonate.

This soil is somewhat poorly drained. Surface runoff is slow. Permeability is moderately slow. Available water capacity is low. The hazard of soil blowing is severe, and the hazard of water erosion is slight. A seasonal water table occurs at 1 to 3 feet below the surface.

Included in mapping are small areas of Nueces, Lozano, and Jarron soils. These included soils make up less than 15 percent of any one mapped area.

This soil is used mainly as rangeland and wildlife habitat.

In rangeland, excess sodium and seasonal wetness are the main limitations. Maintaining desirable grasses and controlled grazing are needed to maintain productivity.

The potential plant community is grasses and a few low shrubs and forbs. The better grasses are seacoast bluestem and fourflower trichloris. Among the major grasses are purple lovegrass, gulf cordgrass, knotroot bristlegrass, sacaton, and paspalums. Other plants are western indigo, sensitivebriar, and mesquite. Gulf cordgrass, knotroot bristlegrass, and paspalums increase under heavy grazing. If heavy grazing is prolonged for

many years, gulf cordgrass will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

This soil is moderately well suited to pasture. Excess sodium and low available water capacity are the main limitations. Proper management that includes rotational grazing and weed control is needed to maintain productivity. Suitable grasses are Coastal bermudagrass, African stargrass, and weeping lovegrass.

This soil is poorly suited to crops. Suitable crops are cotton and grain sorghum. Excess sodium, seasonal wetness, and the severe hazard of soil blowing are the main limitations. Surface and subsurface drainage are needed to increase soil productivity.

This soil is poorly suited to urban and recreation uses. Wetness, excess sodium, and the severe hazard of soil blowing are the main limitations.

This soil is in capability subclass VIs. It is in the Sandy Flat range site.

Sz—Sauz loamy fine sand. This soil is on the low coastal terraces near the bay. The surface is plane and nearly level. Slopes are mainly less than 1 percent but in places range up to 2 percent. Areas are irregularly shaped and range from 40 to 600 acres.

Typically, the surface layer is light brownish gray loamy fine sand about 7 inches thick. The upper part of the subsoil, from 7 to 40 inches, is grayish brown sandy loam in the upper part and grades to light brownish gray sandy clay loam in the lower part. The lower part of the subsoil, from 40 to 55 inches, is light brownish gray fine sandy loam with yellowish brown mottles. The underlying material to a depth of 65 inches is gray fine sandy loam with brownish mottles. This soil is mildly alkaline in the upper part and strongly alkaline in the lower part.

This soil is somewhat poorly drained and sodic. Surface runoff is slow. Permeability is moderately slow. Available water capacity is low because salinity inhibits the intake of water by plants. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. A seasonal saline water table is 1 to 3 feet below the surface.

Included in mapping are small areas of Saucel, Hidalgo, Latina, and Willamar soils. These included soils make up less than 15 percent of any one mapped area.

This soil is used mainly as rangeland and wildlife habitat. Excess sodium and seasonal wetness are the main limitations.

In rangeland, maintaining desirable grasses and controlled grazing are needed to maintain productivity. The potential plant community is grasses and a few low shrubs and forbs. The better major grasses are seacoast bluestem and fourflower trichloris. Other major grasses are purple lovegrass, gulf cordgrass, knotroot bristlegrass, sacaton, and paspalums. Other plants are western indigo, sensitivebriar, and mesquite. Gulf cordgrass, sacaton, and paspalums increase under heavy grazing. If heavy grazing is prolonged for many years, gulf cordgrass will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

This soil is moderately well suited to pasture. Salinity and sodicity are the main limitations. Controlled grazing, fertilization, and weed control are needed to maintain productivity. Suitable grasses are Coastal bermudagrass and weeping lovegrass.

This soil is poorly suited to crops. Wetness, salinity, and the hazard of soil blowing are the main limitations.

This soil is poorly suited to most urban and recreation uses. Excess salt, excess sodium, and seasonal wetness are the main limitations. Surface drains to reduce wetness and salinity are the main needs.

This soil is in capability subclass VIs. It is in the Sandy Flat range site.

Ta—Tatton fine sand. This soil is on salt flats of low coastal terraces on the bay side of Padre Island. The elevation ranges from the low tide level to about 1 foot above the mean sea level. Slopes are less than 0.5 percent. Areas of this soil are broad and 0.5 mile to more than 2 miles wide. They extend the length of the island in the county.

Typically, the surface layer is saline, moderately alkaline, light gray fine sand about 5 inches thick. Below that, from 5 to 12 inches, is saline, moderately alkaline, gray loamy fine sand. The underlying material to a depth of 60 inches is saline, strongly alkaline, light gray fine sand. This soil is calcareous throughout.

This soil is very poorly drained. Runoff is very slow or ponded. Permeability is rapid. Available water capacity is very low. The soil is frequently flooded by seawater. In some areas, it is inundated a few times annually, and in others, it is inundated daily by tides. The surface is commonly submerged in winter during the season of high tides and strong northwesterly winds. It is commonly dry in summer when the hazard of soil blowing is severe. A blue-green mat-forming algae protects the surface from blowing except where it is disturbed and barren. The hazard of water erosion is slight. The water table is 1 foot above the surface to 1 foot below.

Included in mapping are small areas of Satatton soils. These included soils make up less than 15 percent of any one mapped area.

This soil is not suited to range, pasture, or crops. It is used mainly as a wetland wildlife habitat. During winter both marine life and waterfowl feed on algae in the shallow water that is pushed over the flats by strong northwest winds.

This soil is not suited to urban and recreation uses. Flooding, wetness, excess salt, excess sodium, and the sandy texture are the main limitations.

This soil is in capability subclass VIIIs. No range site has been assigned to this unit.

Tc—Tiocano clay. This soil is in depressions that are scattered throughout the high stream terraces. The surface is concave and has a gilgai microrelief. Slopes are less than 1 percent. Areas are roundish or oval and range from 5 to 60 acres.

Typically, the surface layer is dark gray clay about 44 inches thick. It is neutral in the upper 10 inches and mildly alkaline in the lower part. From 44 to 59 inches is moderately alkaline, gray clay mottled with brown. The underlying material to a depth of 70 inches is moderately alkaline, light brownish gray clay loam mottled with strong brown. This soil has a few calcium carbonate concretions in the lower part.

This soil is somewhat poorly drained. It is frequently flooded, ponded, or wet for long periods following heavy rains but is generally dry during the late summer. The water table is 1 foot above to 6 feet below the surface. Permeability is very slow except when the soil is dry and cracked. Available water capacity is moderate. The erosion hazard is none to slight.

Included in mapping are small areas of Rio, Jarron, and Racombes soils mainly on the outer edge of the mapped areas. These included soils make up less than 15 percent of any one mapped area.

This soil is used mostly as waterfowl habitat and rangeland. A few drained areas are used as cropland and pastureland.

This soil has good potential for use as waterfowl habitat. The soil is usually ponded during winter and spring. Maintaining desirable plants for food and cover is the main management need.

In rangeland, wetness is the main limitation. Proper management that includes seasonal grazing is needed to maintain productivity.

The potential plant community is grassland with plants that are tolerant of varying degrees of wetness. The better major grasses are hartweg paspalum, spike lovegrass, and switchgrass. Knotroot bristlegrass and common bermudagrass increase under heavy grazing. Other plants are sedges, rushes, sesbania, and huisache. If heavy grazing occurs for many years, huisache and forbs will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 3,000 pounds in unfavorable years.

This soil is not suited to pasture or crops unless provided with surface drainage. If drained, the soil is moderately well suited to pasture and is poorly suited to crops. Suitable grasses are Coastal bermudagrass and African stargrass.

This soil is not suited to urban and recreation uses. Ponding, high shrink-swell potential, and clayey texture are the main limitations to those uses.

This soil is in capability subclass VIw, nonirrigated, and IVw, drained. It is in the Lakebed range site.

UdB—Udipsamments, gently undulating. These soils are in areas next to the Arroyo Colorado and the Port Mansfield channel to the Gulf where sand has been deposited during dredging. Slopes are 1 to 5 percent. Areas are irregularly round or oblong and range from 4 to 500 acres.

Typically, these soils consist of light gray, calcareous loamy fine sand or sand to a depth of more than 60 inches. They contain many shell fragments.

These soils are deep and somewhat excessively drained. Surface runoff is none to slow. Permeability is rapid. Available water capacity is low. The hazard of soil blowing is severe, and the hazard of water erosion is slight.

Included in mapping are small areas of Camargo and Satatton soils on the outer edge of the mapped areas. These included soils make up less than 20 percent of any one mapped area.

Areas of these soils along the Arroyo Colorado are used as rangeland and wildlife habitat. The areas on Padre Island are used as recreation areas and wildlife habitat.

These soils are poorly suited to pasture grasses. Suitable grasses are weeping lovegrass and Coastal bermudagrass. Low fertility, low available water capacity, and the severe hazard of soil blowing are the main limitations. Controlled grazing, fertilization, and weed control are needed to maintain productivity.

These soils are not suited to crops, mainly because of the severe hazard of soil blowing.

These soils are poorly suited to most urban and recreation uses. The slope, sandy texture, and the severe hazard of soil blowing are the main limitations to those uses.

The soils in this unit are in capability subclass VIIe. They have not been assigned to a range site.

Uf—Ustorthents, loamy. These level soils are on middle and high stream terraces. Slopes are plane and less than 0.1 percent. Areas are irregular and range from 5 to 30 acres.

These soils have been drastically modified by heavy machinery in leveling land for irrigation. The upper 24 to 60 inches of the original soil has been removed by heavy machinery. Some of the soils that have been drastically modified by leveling are the Delfina, Hidalgo, Hargill, and Willacy soils, which originally occupied the higher positions or low ridges on the landscape. In some areas, about 6 inches of the original surface layer has been returned as "backfill" after leveling.

Ustorthents, loamy, typically consist of firm, mildly to moderately alkaline, brown, light brown, very pale brown, reddish brown, yellowish red, or pink sandy clay loam or clay loam.

These soils are deep and well drained. Surface runoff is slow. Permeability is moderate. Available water capacity is moderate. The erosion hazard is none to slight. The high lime content causes iron chlorosis in some plants. Some areas have a seasonal water table.

Included in mapping are saline areas and small areas of Willacy, Hidalgo, Hargill, and Lozano soils. These soils make up less than 25 percent of any one mapped area.

Ustorthents, loamy, are used mainly as cropland, for which they are moderately well suited. Crops that produce large amounts of residue are needed to improve soil tilth. Suitable crops are cotton and grain sorghum in nonirrigated areas and several kinds of vegetables in irrigated areas. Fertilization and the addition of organic materials are needed to increase the availability of iron for plant use. Chlorosis is common in grain sorghum and citrus. Saline areas need subsurface drainage to reduce salinity.

These soils are moderately well suited to irrigated citrus. The main limitation is seasonal wetness. Tile drains can be used to lower the seasonal high water table that can occur under irrigation.

These soils are well suited to pasture grasses. Suitable grasses are Coastal bermudagrass and African stargrass. Controlled grazing and proper grazing use are needed to maintain productivity.

These soils are moderately well suited to most urban and recreation uses. The clayey surface layer is the main limitation.

These soils are in capability subclass IIIs, irrigated or nonirrigated. No range site has been assigned to this unit.

Us—Ustorthents, clayey. These nearly level to gently sloping soils are on ridges along intracoastal waterways where clayey and silty materials have been deposited by dredging operations. Most areas occur as small islands in the shallow seawater of Laguna Madre. Locally the areas are referred to as "spoil banks." The surface is convex and has slopes of 1 to 5 percent. Areas are round to oblong and range from 5 to 100 acres.

The soils are a mixture of gray and brown, rounded clods of clay and sandy clay to a depth of 60 inches. The clods are mixed with sandy materials, shell fragments, and concretions. The soils are saline, strongly alkaline, and calcareous.

These soils are moderately well drained. Runoff is rapid on the steeper slopes. Permeability is very slow. The hazard of water erosion is severe. The hazard of soil blowing is slight. Available water capacity is very low because salinity inhibits the intake of water by plants.

Included in mapping are small areas of Barrada, Arrada, Satatton, and Tatton soils. These included soils make up less than 25 percent of any one mapped area.

These soils are used mainly as wildlife habitat. They grow mostly salt-tolerant plants such as gulf cordgrass, bushy sea-oxeye, saltwort, and seashore saltgrass.

These soils are poorly suited to all uses. Salinity, very slow permeability, a severe hazard of water erosion, and clayey texture are the main limitations.

The soils in this unit are in capability subclass VIIIs. They have not been assigned to a range site.

WaA—Willacy fine sandy loam, 0 to 1 percent slopes. This nearly level soil is on ridges of the middle stream terraces. The surface is plane to slightly convex. Areas are irregularly shaped and range from 10 to 100 acres.

Typically, the surface layer is neutral, grayish brown fine sandy loam about 14 inches thick. The upper part of the subsoil, from 14 to 36 inches, is mildly alkaline sandy clay loam that is grayish brown in the upper part and brown in the lower part. The lower part of the subsoil, from 36 to 44 inches, is moderately alkaline, pale brown sandy clay loam. The underlying material to a depth of 65 inches is moderately alkaline, very pale brown sandy clay loam with many masses of calcium carbonate.

This soil is deep and well drained. Surface runoff is medium. Permeability is moderate. Available water capacity is high. The hazard of water erosion is slight. The hazard of soil blowing is moderate.

Included in mapping are small areas of Hargill, Hidalgo, Delfina, and Racombes soils. These included soils make up less than 25 percent of any one mapped area.

This soil is used mostly as cropland, for which it is well suited. Lack of moisture is a limitation to yields during dry periods in nonirrigated areas. Suitable nonirrigated crops are cotton and grain sorghum, and suitable irrigated crops are sugarcane (fig. 8) and a variety of vegetables. This soil is well suited to irrigated citrus. Cropping systems that include crops that produce a large amount of residue are needed to maintain soil tilth. Bedding, or listing, the soil on the contour will help conserve moisture and reduce soil blowing.

This soil is well suited to pasture grasses. Proper management that includes fertilization, controlled grazing, and weed control are needed to maintain productivity. Suitable grasses are Coastal bermudagrass, buffelgrass, and introduced bluestems.

In some areas this soil is used as rangeland and wildlife habitat. In rangeland, controlled grazing and proper stocking are needed to maintain productivity.

The potential plant community is mid grasses and some forbs and woody plants. The better grasses are fourflower trichloris, plains bristlegrass, Arizona cottontop, and silver bluestem. Hooded windmillgrass, fall witchgrass, and threeawn increase under most grazing systems commonly used in the area. The major forbs and woody plants are Engelmann-daisy, sensitivebriar, spiny hackberry, mesquite, and pricklypear. If heavy grazing occurs for many years, thorny brush will dominate. The potential production per

Figure 8.—Sugarcane harvesting on Willacy fine sandy loam, 0 to 1 percent slopes.

acre when the range is in excellent condition is 5,400 pounds, dry weight, in favorable years and 3,000 pounds in unfavorable years.

This soil is well suited to urban and recreation uses.

This soil is in capability subclass IIc, nonirrigated, and class I, irrigated. It is in the Sandy Loam range site.

WaB—Willacy fine sandy loam, 1 to 3 percent slopes. This gently sloping soil is on low ridges of middle stream terraces. The surface is convex. Areas are irregularly round or oblong and range from 20 to 150 acres.

Typically, the surface layer is dark grayish brown fine sandy loam about 13 inches thick. The upper part of the subsoil, from 13 to 39 inches, is a neutral sandy clay loam that is dark brown in the upper part and brown in the lower part. The lower part of the subsoil, from 39 to 49 inches, is moderately alkaline, pale brown sandy loam. The underlying material to a depth of 80 inches is moderately alkaline, very pale brown sandy clay loam with soft masses of calcium carbonate. This soil is neutral in the upper part and moderately alkaline in the lower part.

This soil is deep and well drained. Surface runoff is medium. Permeability is moderate. Available water capacity is high. The hazards of water erosion and soil blowing are moderate.

Included in mapping are small areas of Hidalgo and Lozano soils. These included soils make up less than 25 percent of any one mapped area.

In most areas this soil is used as cropland. In a few areas it is used for range and pasture. In a few areas, in the towns of Raymondville and Lyford, it is used as urban and built-up land.

This soil is well suited to crops. In nonirrigated areas, however, crop yields are reduced during dry periods. Suitable nonirrigated crops are cotton and grain sorghum, and suitable irrigated crops are sugarcane and vegetables. This soil is well suited to irrigated citrus. Conserving moisture and controlling erosion are the main needs of management. Bedding, or listing, the soil and proper use of crop residue during the fallow period will prevent most of the soil blowing. Farming the soil on the contour will help prevent most of the water erosion and help retain moisture.

This soil is well suited to pasture. Proper management that includes fertilization, controlled grazing, and weed control are needed to maintain productivity. The suitable grasses are Coastal bermudagrass, buffelgrass, and introduced bluestem.

Some areas are used as rangeland. Proper range management should include brush control and controlled grazing to maintain productivity. The potential plant community is mid grasses, some forbs, and woody plants. The major grasses are fourflower trichloris, plains bristlegrass, Arizona cottontop, and silvery bluestem. Hooded windmillgrass, fall witchgrass, and threeawn increase under heavy grazing. The major forbs and woody plants are Engelmann-daisy, sensitivebriar, spiny hackberry, mesquite, and pricklypear. If heavy grazing occurs for many years, thorny brush will dominate. The potential production per acre when the range is in excellent condition is 5,400 pounds, dry weight, in favorable years and 3,000 pounds in unfavorable years.

This soil is well suited to urban and recreation uses.

This soil is in capability subclass IIe, irrigated or nonirrigated. It is in the Sandy Loam range site.

Wf—Willamar fine sandy loam. This soil is on the low coastal terraces. The surface is plane to slightly concave and has slopes of less than 1 percent. Areas are irregular and range from 5 to 300 acres.

Typically, the surface layer is neutral fine sandy loam about 6 inches thick that is grayish brown in the upper part and gray in the lower part. The subsoil, from 6 to 28 inches, is moderately alkaline sandy clay loam that is grayish in the upper part and brownish in the lower part. The underlying material from 28 to 65 inches is very pale brown clay loam that is strongly saline and has many soft masses of calcium carbonate.

This soil is somewhat poorly drained and sodic. Surface runoff is slow. Permeability is very slow. Available water capacity is very low because salinity inhibits the intake of water by plants. The erosion hazard is slight. The water table is within 3 to 6 feet of the surface for one or more months in most years, mainly during the spring and fall.

Included in mapping are small areas of Lozano, Latina, and Porfirio soils. These included soils make up less than 15 percent of any one mapped area.

In most areas, this soil is used as rangeland. In a few areas, it is used as pastureland, cropland, and wildlife habitat.

In rangeland, salinity and wetness are the main limitations. Controlled grazing and proper use of forage are needed to maintain productivity. The potential plant community is grasses and a few low shrubs and forbs. The better grasses are Texas cottontop, pappusgrass, and fourflower trichloris. Among the grasses are purple lovegrass, gulf cordgrass, knotroot bristlegrass, sacaton, and paspalum. Other plants are western indigo, sensitivebriar, and mesquite. If heavy grazing occurs for many years, knotroot bristlegrass, threeawn, and gulf cordgrass will increase and may dominate. The potential production per acre when the range is in excellent condition is 5,500 pounds, dry weight, in favorable years and 2,500 pounds in unfavorable years.

This soil is moderately well suited to pasture. Salinity and wetness are the main limitations. Controlled grazing, fertilization, and weed control are needed to maintain productivity. Providing surface drainage will help reduce salinity and wetness. The suitable salt-tolerant grasses are Coastal bermudagrass and African stargrass.

This soil is poorly suited to crops. Salinity and wetness are the main limitations. Cropping systems should include crops that produce large amounts of residue to maintain soil tilth. A suitable crop is cotton. Surface and subsurface drainage can help reduce salinity and wetness. Adding soil amendments such as gypsum or sulfur can help reduce the sodicity of the soil, which causes surface crusting (fig. 9), and improve the water intake rate.

This soil is poorly suited to most urban and recreation uses. Wetness, excess salt, and excess sodium are the main limitations.

This soil is in capability subclass IVs, nonirrigated, and IIIs irrigated. It is in the Sandy Coastal Flat range site.

Ws—Willamar fine sandy loam, strongly saline. This soil is in depressions on the low coastal terraces. The surface is plane to slightly concave and has slopes of less than 1 percent. Areas are irregularly shaped and range from 10 to 300 acres.

This soil is strongly saline. Typically, the surface layer is moderately alkaline, dark gray fine sandy loam about 6 inches thick. The subsoil, from 6 to 36 inches, is strongly alkaline, brownish sandy clay that has common masses of calcium carbonate in the lower part. The underlying layer to a depth of 60 inches is strongly alkaline, pale brown clay loam with many soft masses of calcium carbonate.

This soil is somewhat poorly drained. Surface runoff is slow to ponded. The available water capacity is very low. Permeability is very slow. The water table is 1 foot above

Figure 9.—Cultivated field of Willamar fine sandy loam showing the crust that forms on the surface after a rain.

to 3 feet below the surface for one or more months in most years. The erosion hazard is slight.

Included in mapping are small areas of saline Racombes, Rio, Hidalgo, and Raymondville soils. These included soils make up less than 25 percent of any one mapped area.

In most areas, this soil is idle because of high salinity. A few areas are used as rangeland and as wildlife habitat.

In rangeland, salinity and wetness are the main limitations. Controlled grazing is needed to maintain productivity. The native vegetation consists of salt-tolerant plants, such as gulf cordgrass, bushy sea-oxeye, and pickleweed.

This soil is not suited to crops or pasture because of high salinity. The soil can be reclaimed by providing drainage to reduce salinity.

This soil is not suited to urban uses and is poorly suited to recreation uses. Wetness, excess sodium, and excess salts are the main limitations.

This soil is in capability subclass VIs. No range site has been assigned to this unit.

Yf—Yturria fine sandy loam. This gently sloping soil is on ridges on high stream terraces. The surface is convex and has slopes of 1 to 5 percent. Areas are round to oblong and range from 20 to 200 acres.

Typically, the surface layer is neutral to mildly alkaline, grayish brown fine sandy loam about 26 inches thick. The subsoil, from 26 to 44 inches, is moderately alkaline, light brownish gray fine sandy loam with a few masses of calcium carbonate. The underlying material to a depth of 65 inches is moderately alkaline, pale brown fine sandy loam with many soft masses of calcium carbonate.

This soil is well drained. Surface runoff is slow. Permeability is moderately rapid. Available water capacity is moderate. The hazard of soil blowing is moderate. The hazard of water erosion is slight.

Included in mapping are small areas of Willacy, Hidalgo, and Racombes soils. These included soils make up less than 15 percent of a mapped area.

This soil is used mainly as rangeland. In a few areas it is used as pastureland, nonirrigated cropland, and wildlife habitat.

In rangeland, maintaining desirable grasses and plants, controlled grazing, and brush control are needed to maintain productivity.

The potential plant community is mid grasses with some forbs and woody plants. The major grasses are fourflower trichloris, plains bristlegrass, Arizona cottontop, and silver bluestem. Hooded windmillgrass, fall witchgrass, and threeawn increase under heavy grazing. The major forbs and woody plants are Engelmann-daisy, sensitivebriar, spiny hackberry, mesquite, and pricklypear.

If heavy grazing occurs for many years, thorny brush will dominate. The potential production per acre when the range is in excellent condition is 5,000 pounds, dry weight, in favorable years and 2,000 pounds in unfavorable years.

This soil is well suited to pasture. Proper management that includes fertilization, controlled grazing, and weed control are needed to maintain productivity. Suitable grasses are buffelgrass and Coastal bermudagrass.

This soil is well suited to crops. During dry periods, a lack of soil moisture can reduce crop yields. A cropping system that maintains crop residue on the surface is needed to maintain soil tilth and reduce soil blowing. Suitable crops are cotton and grain sorghum. Farming on the contour will help conserve soil moisture.

This soil is well suited to most urban and recreation uses.

This soil is in capability subclass IIc, nonirrigated, and class I, irrigated. It is in the Sandy Loam range site.

Prime farmland

In this section, prime farmland is defined and discussed, and the prime farmland soils in Willacy County are listed.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in providing the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land and water areas cannot be considered prime farmland.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not flooded during the growing season. The slope ranges mainly from 0 to 5 percent.

Soils that have a high water table, are subject to flooding, or are droughty may qualify as prime farmland soils if the limitations are overcome by drainage, flood control, or irrigation. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information on the criteria for prime farmland soils can be obtained at the local office of the Soil Conservation Service.

Prime farmland in Willacy County

Nearly 195,000 acres, or about 41 percent of the county, is prime farmland. The areas on the deltaic plains and uplands in the county are dominantly prime farmland. Many areas throughout the rest of the county are also prime farmland. The largest areas are in map units 1, 2, 3, 4, 5, and 6 on the general soil map.

Approximately 150,000 acres of this prime farmland is used for cultivated crops. Crops grown on these soils, mainly grain sorghum and cotton, account for the larger part of the county's total agricultural income each year.

A recent trend in land use has been the conversion of prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are wet, more erodible, droughty, or difficult to cultivate and less productive than prime farmland.

The following map units, or soils, make up prime farmland in Willacy County. On some soils included in the list, appropriate practices have been applied to overcome droughtiness. Where the soils are irrigated, there is a dependable and adequate supply of irrigation water. The location of each map unit is shown on the detailed soil maps at the back of the publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed soil map units." This list does not constitute a recommendation for a particular land use.

An	Arents, loamy (where irrigated)
Ca	Camargo silty clay loam
DeA	Delfina loamy fine sand, 0 to 2 percent slopes (where irrigated)
DfA	Delfina fine sandy loam, 0 to 1 percent slopes
DfB	Delfina fine sandy loam, 1 to 3 percent slopes
HaA	Hargill fine sandy loam, 0 to 1 percent slopes
HaB	Hargill fine sandy loam, 1 to 3 percent slopes
HgB	Hidalgo fine sandy loam, 1 to 3 percent slopes
HoA	Hidalgo sandy clay loam, 0 to 1 percent slopes
Ln	Lozano fine sandy loam
Ly	Lyford sandy clay loam
Me	Mercedes clay (where irrigated)
Ra	Racombes sandy clay loam
Rd	Raymondville clay loam

WaA	Willacy fine sandy loam, 0 to 1 percent slopes
WaB	Willacy fine sandy loam, 1 to 3 percent slopes
Yf	Yturria fine sandy loam (where irrigated)

Use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 44 percent of the county, or 210,000 acres, is cultivated. These figures are from the records of the local field office of the Soil Conservation Service. Most of this total is in nonirrigated cropland planted almost exclusively to grain sorghum and cotton. The major concern is the inherent high saline water table and salt problems caused by poor surface drainage. Some areas are leveled to eliminate ponding and to conserve rainfall.

About 35,000 acres of the cultivated soils is irrigated. Water is pumped from the Rio Grande through a canal to Delta Lake, where it is stored and subsequently delivered to irrigated farms by a series of elevated canals. About 2 acre-feet of water is allocated to each irrigation acre in the water district. The main irrigated crops are onions, potatoes, cabbage, lettuce, beets, turnips, broccoli, cotton, grain sorghum, sugarcane, citrus, and improved pasture. Pasture grasses are buffelgrass, improved bermudagrass. African stargrass, and sand lovegrass.

Most irrigated soils require surface and subsurface drainage as well as a dependable supply of quality irrigation water for maximum productivity. Tile and pumped-well drainage systems are used in some areas to lower the high water table and to facilitate leaching of salts.

Most irrigated soils are improved by land leveling. In leveled areas, water is used more efficiently, and it is applied more quickly. Land leveling along with surface and subsurface drainage also helps to leach toxic salts.

Soil erosion is a concern on about 30 percent of the cropland in Willacy County. Soil blowing is the major concern on the soils that have a surface layer of fine sandy loam or loamy fine sand. If the surface is dry and loose, soil blowing can be severe. Water erosion is a concern on about 10 percent of the cropland. If slope is more than 1 percent, water erosion is a hazard. The Hargill, Delfina, Lozano, Willacy, and Yturria soils have a moderate hazard of soil blowing, and these soils that are gently sloping have a moderate hazard of water erosion.

Surface drainage is a concern on about 75 percent of the cropland. Soils that have slow surface drainage,

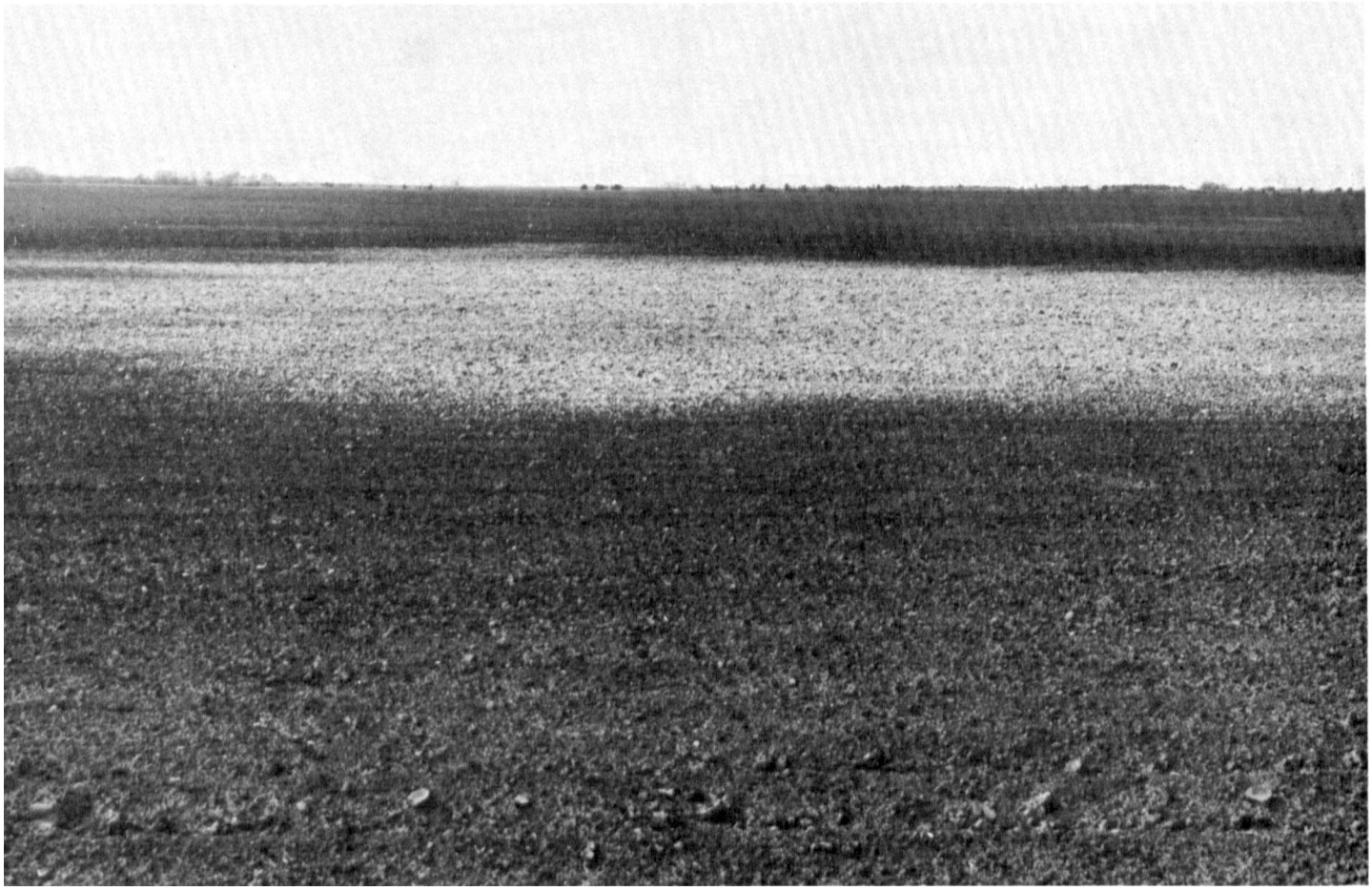


Figure 10.—Small areas of Willamar soils, known as "hot spots," within a large area of Lyford soils. These saline spots are shown on the detailed soil maps by a special symbol.

such as Hidalgo, Lyford, Mercedes, Porfirio, Racombes, Raymondville, and Willamar soils, are subject to flooding and ponding during periods of excessive rainfall.

Subsurface drainage is a concern on about 50 percent of the cropland. Most low areas have a seasonal high water table within the root zone. The inherent extremely saline and sodic water table that underlies most cropland in the county is 5 feet or more below the soil surface (*15*) most of the time. During periods of excessive rainfall and because of water added during irrigation, the water table rises almost to the surface and increases the salinity (fig. 10) and sodicity of the soils. As a result, the soils become droughty, more difficult to cultivate, and, therefore, less productive. Soils suitable for crops that have a seasonal high water table and that need subsurface drainage are Delfina, Lozano, Lyford, Porfirio, Racombes, and Willamar soils. Other soils in cropland that may develop a high water table and salinity are Hidalgo, Mercedes, and Raymondville soils.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium,

and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Rangeland

According to records of the local field office of the Soil Conservation Service, about 33 percent, or 155,000 acres, of the county is used for livestock production. The ranches vary in size from about 500 to 70,000 acres. Most of the land used for ranching is not suitable for rowcropping. Except for the highly saline and sandy soils, most soils have a heavy infestation of mixed brush. In this county, most ranchers control the brush with herbicides and mechanical methods followed by reseeding to native or adapted improved grasses.

Different range sites require different treatment depending upon their condition and the kind and density of undesirable vegetation. They may require extensive brush control measures, such as chaining, rootplowing, root raking, and seeding to a native or adapted grass, or simply a disking and seeding to a native or adapted species. In some areas, however, only cross fences and facilities for watering livestock are needed to improve range condition and livestock production. A grazing system that includes deferment, or rest periods, is a vital part of grass and livestock management.

To minimize detrimental effects that brush removal may have on wildlife habitat, most ranchers plan their brush management methods so as to leave brush strips or brushy areas for food and cover for wildlife. Wildlife is a valuable commodity to the rancher, from esthetic and economic aspects. Most of the range abounds in wildlife, including deer, nilgai antelope, javelina, turkey, quail, and dove.

The information in table 7 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 10 and interpretations for dwellings without basements and for local roads and streets in table 9.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife habitat

Wildlife commonly found in the county include nilgai antelope, white-tailed deer, javelina, coyote, bobwhite quail, dove, meadowlark, and jackrabbit.

Wildlife is a significant part of the economy on most ranches in the county. Deer hunting is the main commercial sport and is an important source of income. A healthy deer population will enhance the ranch value and provide more income from hunting. The demand for good places to hunt deer is far greater than the available supply.

Deer are usually managed in conjunction with the livestock operation. Generally, most range management practices for livestock are also advantageous to deer and other wildlife. In brush control, the leaving of brush strips for food and cover is especially beneficial to deer. Information about the soils will aid landowners in providing a suitable habitat for wildlife.

The wetlands of the county are vital to waterfowl. Lakes, bays, coastal lowlands, and inland playas and ponds provide the main winter habitat for ducks and geese of the central flyway.

Brushland and citrus orchards are nesting areas for white-winged dove and mourning dove. A few small brushy areas are leased and maintained by the State of Texas and used as nesting areas for white-winged dove.

Other important game animals on ranches are turkey, bobwhite quail, and javelina. Nilgai antelope, a transplant, and feral hog live on ranches in the northeastern part of the county. Maintaining desirable plants for food and cover is the main need.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 8, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are anacahuita, acacia, sumac, and cenizo.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, white-winged dove, meadowlark, field sparrow, cottontail, and cranes.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, shore birds, frogs, and feral hogs.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, white-tailed deer, meadowlark, coyote, and jackrabbit.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes

for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building site development

Table 9 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to a very firm dense layer; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, and shrink-swell potential can cause the movement of footings. A high water table and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary facilities

Table 10 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 10 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site

features, and observed performance of the soils. Permeability, a high water table, and flooding affect absorption of the effluent.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 10 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, flooding, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope can cause construction problems.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 10 are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, slope, and flooding affect both types of landfill. Texture, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction materials

Table 11 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by a high water table and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 11, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by coarse fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water management

Table 12 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, and terraces and diversions.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content

of salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; and susceptibility to flooding. Excavating and grading and the stability of ditchbanks are affected by slope and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope and wetness affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 16.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering index properties

Table 13 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*3*) and the system adopted by the American Association of State Highway and Transportation Officials (*2*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 16.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and chemical properties

Table 14 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation (*19*). It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 14, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and water features

Table 15 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Farm roads, highways, railways, and other manmade structures may restrict surface drainage and cause flooding on some soils that ordinarily are not subject to flooding. In these areas flooding will change as roads are constructed or surface drainage improved.

Water standing on soils for short periods after rainfall or water standing in marshes is considered ponding.

Table 15 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 15.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering index test data

Table 16 shows laboratory test data for five pedons sampled at carefully selected sites in the survey area. Four of these pedons are typical of the series and are described in the section "Soil series and their morphology." The pedon for the Delfina soil is not typical of the series; however, the soil behavior is the same as in the named series. The soil samples were tested by Texas State Department of Highways and Public Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Specific gravity (Particle index)—T 100 (AASHTO), D 698 (ASTM); Shrinkage—T 92 (AASHTO), D 427 (ASTM).

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*20*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 17, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquents (*Hapl*, meaning minimal horizonation, plus *aquent*, the suborder of the Entisols that have an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, nonacid, mesic Typic Haplaquents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described The detailed description of each soil horizon follows standards in the Soil Survey Manual (*18*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*20*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Arrada series

The Arrada series consists of deep, nearly level, poorly drained loamy soils. These are extremely saline soils on salt flats and drainageways of low coastal terraces. The surface is plane to concave. The soils are frequently ponded. Slopes are less than 1 percent.

Typical pedon of Arrada sandy clay loam; from Raymondville, 26 miles east on Texas Highway 186 and Farm Road 497 to Port Mansfield, then to north end of Farm Road 606, and 0.5 mile west (100 feet south of fence):

Asa—0 to 5 inches; gray (5Y 6/1) sandy clay loam, gray (5Y 5/1) moist; weak medium platy structure and vesicular; slightly hard, friable; 50 percent by volume crystals and grains of salt; extremely saline; calcareous; strongly alkaline; abrupt smooth boundary.

ACsa—5 to 16 inches; gray (5Y 5/1) sandy clay loam, gray (5Y 6/1) moist; few medium distinct dark brown mottles; weak medium prismatic structure parting to subangular blocky; slightly hard, friable; few white concretions of calcium carbonate and crystalline salts; extremely saline; calcareous; strongly alkaline; clear smooth boundary.

C1sa—16 to 32 inches; gray (5Y 6/1) sandy clay loam, gray (5Y 5/1) moist; few fine distinct light olive brown mottles; massive; slightly hard, friable; few black concretions; extremely saline; calcareous; strongly alkaline; clear smooth boundary.

C2sa—32 to 54 inches; white (5Y 8/2) sandy clay loam, light gray (5Y 7/2) moist; many medium prominent yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable; few fine concretions of calcium carbonate; extremely saline; calcareous; strongly alkaline; clear smooth boundary.

C3gsa—54 to 80 inches; light greenish gray (5GY 7/1) sandy clay loam, greenish gray (5GY 6/1) moist; massive; slightly hard, friable; few fine concretions of calcium carbonate; extremely saline; calcareous; strongly alkaline.

Depth to sand or clay ranges from 40 to more than 80 inches. The upper part of the soil is fine sandy loam, sandy clay loam, or clay loam. Below a depth of 40 inches, the sediments range from loamy fine sand to clay. Some are stratified. The salt content ranges from 2 to 40 percent by weight. Concretions of calcium carbonate and other crystalline salts make up 1 to 30 percent of the volume. The soil is moderately alkaline or strongly alkaline throughout.

All horizons when moist are light gray, gray, grayish brown, light brownish gray, light olive gray, pale olive, or greenish gray. When the soil is dry, colors are one value higher than when it is moist. Mottles are in shades of olive, yellow, and brown.

Barrada series

The Barrada series consists of deep, nearly level, very poorly drained clayey soils. These soils are extremely saline. They occur on tidal flats of low coastal terraces. The surface is plane to concave and is commonly ponded. Slopes are less than 0.5 percent.

Typical pedon of Barrada clay; from the point where fence crosses beach on the south boundary of the Port Mansfield area; 0.3 mile west, in center of a tidal flat:

C1gsa—0 to 4 inches; gray (N 5/0) clay, dark gray (N 4/0) moist; few fine distinct yellowish brown mottles along cracks; massive; hard, firm; many specks and films of segregated salt in lower part; extremely saline; calcareous; strongly alkaline; abrupt smooth boundary.

C2gsa—4 to 12 inches; gray (N 5/0) clay, dark gray (N 4/0) moist; in thin layers 1/8 to 1/2 inch thick between layers of white crystalline salt; massive with distinct bedding planes; 50 percent by volume salt; extremely saline; calcareous; strongly alkaline; abrupt smooth boundary.

C3gsa—12 to 40 inches; gray (N 5/0) clay, dark gray (N 4/0) moist; in layers up to 4 inches thick between layers up to 1/2 inch thick of white crystalline salts; massive with distinct bedding planes; 15 percent by volume salt; extremely saline; calcareous; strongly alkaline; abrupt smooth boundary.

IIC1gsa—40 to 48 inches; greenish gray (5GY 6/1) sandy clay loam, greenish gray (5GY 5/1) moist; massive; few soft salt masses and concretions of calcium carbonate; few dark gray to black films; many white specks of salt; extremely saline; calcareous; strongly alkaline; clear smooth boundary.

IIC2sa—48 to 60 inches; pale olive (5Y 6/3) sandy clay loam, olive (5Y 5/3) moist; many coarse distinct yellowish brown (10YR 5/4) mottles; massive; many white specks of salt; extremely saline; calcareous; strongly alkaline.

The clay content of the control section between depths of 10 and 40 inches ranges from 35 to 60 percent. The volume of salt ranges from 2 to 25 percent. The soils are strongly alkaline or very strongly alkaline throughout.

The C horizon is stratified clay and salt strata or bedding planes to a depth of 36 to 50 inches. When moist, the soil in this horizon is dark gray, gray, or greenish gray. Thickness of salt layers ranges from 0.1 inch to 2 inches. The *n* values below a depth of 20 inches range from about 0.6 to 0.8.

The IIC horizon, when moist, is gray, greenish gray, or olive. It is sandy loam or sandy clay loam. Some pedons have yellowish brown mottles in this horizon.

Camargo series

The Camargo series consists of deep, nearly level, well drained silty soils. These are calcareous soils that are on flood plains of the Arroyo Colorado. The surface is plane. Slopes are 0 to 1 percent.

Typical pedon of Camargo silty clay loam; from the junction of south county line and the Arroyo Colorado, 0.9 mile north on county road and 50 feet east:

A1—0 to 9 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; hard, friable; many fine roots; calcareous; moderately alkaline; abrupt smooth boundary.

C1—9 to 30 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; massive parting to platy and blocky fragments; hard, friable; evident bedding planes; common fine roots; calcareous; moderately alkaline; abrupt smooth boundary.

C2—30 to 42 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; few fine roots; calcareous; moderately alkaline; abrupt smooth boundary.

IIA1b—42 to 53 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure; hard, firm; few fine roots; few white threads of calcium carbonate and salt; calcareous; moderately alkaline; clear smooth boundary.

IIC1—53 to 65 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; massive parting to blocky fragments; very hard, very firm; few fine roots; few white threads of calcium carbonate and salt; calcareous; moderately alkaline.

Depth to strongly contrasting textures of clay or sand is more than 40 inches. The control section (between depths of 10 and 40 inches) is silty clay loam, loam, or silt loam. Bedding planes are evident below the A horizon. The A and C horizons are grayish brown, light brownish gray, pale brown, brown, and very pale brown.

Delfina series

The Delfina series consists of deep, nearly level and gently sloping, moderately well drained loamy soils on high stream terraces. The surface is plane to convex. Slopes range from 0 to 3 percent.

Typical pedon of Delfina sandy loam, 0 to 1 percent slopes; from the junction of Farm Road 1015 and Farm Road 490 near Lasara, 0.7 mile south on Farm Road 1015, 1.7 miles west on county road, 300 feet south and 300 feet east:

Ap—0 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard friable; common fine roots; neutral; abrupt wavy boundary.

A1—7 to 15 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable; few fine roots and pores; neutral; clear smooth boundary.

B21t—15 to 20 inches; dark brown (7.5YR 4/2) sandy clay loam, dark brown (7.5YR 3/2) moist; dark yellowish brown (10YR 4/4) moist when crushed; common fine distinct yellowish red (5YR 4/6), grayish brown (10YR 5/2), and strong brown (7.5YR 5/6) mottles; strong fine and medium blocky structure; extremely hard, firm; few fine and medium roots; common very fine pores; thick continuous clay films and very dark brown organic coatings on vertical and horizontal surfaces of peds; few fine black and brown concretions; neutral; gradual wavy boundary.

B22t—20 to 33 inches; brown (7.5YR 5/2) sandy clay loam, dark brown (7.5YR 4/2) moist; common medium distinct yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) mottles; moderate fine and medium blocky structure; extremely hard, firm; few fine roots; few fine pores; thick continuous clay films and very dark brown organic coatings on vertical and horizontal surfaces of peds; common fine black and brown concretions; neutral; gradual wavy boundary.

B23t—33 to 47 inches; light brown (7.5YR 6/4) sandy clay loam, dark brown (7.5YR 4/4) moist; few faint grayish brown mottles; weak fine subangular blocky structure; hard, friable; few very fine pores; thick patchy clay films; mildly alkaline; clear wavy boundary.

B24tca—47 to 80 inches; reddish yellow (7.5YR 7/6) sandy clay loam, reddish yellow (7.5YR 6/6) moist; weak fine subangular blocky structure; hard, friable; few very fine pores; thin patchy clay films; 3 to 5 percent by volume soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

Solum thickness ranges from 60 to more than 80 inches. Depth to secondary carbonates ranges from 36 to 58 inches. A seasonal water table at a depth of 2.5 to 5 feet occurs in most years in irrigated areas.

The A horizon is grayish brown, dark grayish brown, dark brown, or brown fine sandy loam or loamy fine sand. It is slightly acid or neutral.

The B21t and B22t horizons are dark brown and brown, and they have few to common, faint to distinct yellowish brown, strong brown, yellowish red, or brown mottles. Texture is sandy clay loam or clay loam that has an average clay content of 25 to 30 percent. Reaction is neutral to moderately alkaline.

The B23t horizon is brown, light brown, yellowish brown, light yellowish brown, or strong brown and has few to common faint to distinct brownish, yellowish, and reddish mottles. Texture is sandy clay loam or clay loam. Reaction is neutral or mildly alkaline.

The Btca horizon is light brownish gray, pink, reddish yellow, brownish yellow, light yellowish brown, or yellow. It is sandy clay loam or fine sandy loam. The amount of

calcium carbonates ranges from a few masses and concretions to about 5 percent by volume.

Falfurrias series

The Falfurrias series consists of deep, nearly level to hummocky, somewhat excessively drained sandy soils on the eolian sand sheet. The surface is convex. Slopes are 1 to 5 percent.

Typical pedon of Falfurrias fine sand, gently undulating; from the junction of U.S. Highway 77 and the Kenedy-Willacy County line, 10.25 miles east:

A11—0 to 6 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; very friable; many fine roots; mildly alkaline; clear smooth boundary.

A12—6 to 18 inches; pale brown (10YR 6/3) fine sand, dark brown (10YR 4/3) moist; weak fine granular structure; very friable; common fine roots; neutral; gradual smooth boundary.

A13—18 to 30 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grained; loose; few fine roots; neutral; gradual smooth boundary.

C—30 to 80 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grained; loose; mildly alkaline; noncalcareous.

The combined thickness of the A and C horizons is more than 80 inches. Texture is fine sand or loamy fine sand throughout. The reaction ranges from slightly acid to mildly alkaline. The A horizon is grayish brown, light brownish gray, or pale brown. The C horizon is very pale brown or light yellowish brown.

Galveston series

The Galveston series consists of deep, nearly level to hummocky, somewhat excessively drained sandy soils. These soils are on ridges and dunes of the barrier island and low coastal terraces. The surface is convex. Slopes are 1 to 30 percent.

Typical pedon of Galveston fine sand, gently undulating; from the entrance to Port Mansfield area, 0.1 mile east and 300 feet north:

A—0 to 6 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grained; loose; common fine roots; calcareous; moderately alkaline.

C1—6 to 30 inches; light brownish gray (10YR 6/2) fine sand, light brownish gray (10YR 6/2) moist; single grained; loose; a few fine roots; calcareous; moderately alkaline.

C2—30 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grained; loose; calcareous; moderately alkaline; clear smooth boundary.

C3—60 to 65 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; few fine yellowish brown mottles; single grained; loose; calcareous; moderately alkaline.

Depth to loamy material is more than 72 inches. The soil is slightly acid to moderately alkaline throughout.

The A horizon is light brownish gray or pale brown. The C horizon is light brownish gray, pale brown, very pale brown, or light gray.

Hargill series

The Hargill series consists of deep, nearly level and gently sloping, well drained loamy soils. These soils are on low ridges of high stream terraces. The surface is convex

Typical pedon of Hargill fine sandy loam, 0 to 1 percent slopes; from the junction of Farm Road 490 and Texas Highway 88, 2.7 miles west on Farm Road 490 and 100 feet east, in an orchard:

Ap—0 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

A1—7 to 14 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

B21t—14 to 19 inches; dark brown (7.5YR 4/2) sandy clay loam, dark brown (7.5YR 3/2) moist; moderate medium prismatic structure; slightly hard, friable; distinct clay films on faces of peds; neutral; gradual smooth boundary.

B22t—19 to 34 inches; dark brown (7.5YR 4/4) sandy clay loam, dark brown (7.5YR 4/2) moist; weak medium prismatic structure; hard, firm; few patchy clay films and dark gray stains on faces of peds; mildly alkaline; clear smooth boundary.

B23t—34 to 42 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; moderate medium and fine prismatic structure parting to subangular blocky; hard, firm; few dark gray splotches and streaks; moderately alkaline; clear smooth boundary.

B24tca—42 to 65 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; weak fine subangular blocky structure; slightly hard, friable; many fine masses and concretions of calcium carbonate; calcareous; moderately alkaline.

Solum thickness ranges from 60 to more than 80 inches. Depth to secondary carbonates is 36 to 60 inches. The mollic epipedon is 12 to 20 inches thick.

The A horizon is grayish brown, dark grayish brown, dark brown, or brown. It is neutral or mildly alkaline.

The upper part of the Bt horizon is brown, reddish brown, or dark brown. Clay content ranges from 25 to 32 percent. This horizon is neutral or mildly alkaline.

The Btca horizon is brown, light brown, or reddish yellow. Texture is sandy clay loam or clay loam. Pedons that have matrix colors of 4 or less have common or many reddish and yellowish mottles with chroma of 6 or 8. The Btca horizon is mildly alkaline to moderately alkaline. It has a few to many masses and concretions of calcium carbonate.

Hidalgo series

The Hidalgo series consists of deep, nearly level to gently sloping, well drained loamy soils. These are calcareous soils. They are on middle and high stream terraces. The surface is plane to convex. Slopes range from 0 to 3 percent.

Typical pedon of Hidalgo sandy clay loam, 0 to 1 percent slopes; from junction of Texas Highway 186 and Farm Road 1761 east of Raymondville, 0.4 mile north on Farm Road 1761, and 0.1 mile east on south side of an irrigation canal (100 feet north of an oil well):

Ap—0 to 7 inches; grayish brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure parting to granular; hard, friable; few snail shell fragments; calcareous; moderately alkaline; clear smooth boundary.

A1—7 to 14 inches; grayish brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; few snail shell fragments; calcareous; moderately alkaline; clear smooth boundary.

B21ca—14 to 18 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable; many threads and films of calcium carbonate; many snail shell fragments; calcareous; moderately alkaline; gradual smooth boundary.

B22ca—18 to 42 inches; pale brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable; 5 percent by volume fine soft masses of calcium carbonate; many snail shell fragments; calcareous; moderately alkaline; gradual smooth boundary.

Cca—42 to 60 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; massive; hard, firm; 10 percent by volume fine soft masses and concretions of calcium carbonate; few shell fragments; calcareous; moderately alkaline.

Thickness of the solum ranges from 36 to 48 inches. Secondary calcium carbonate in the form of films and segregates is at a depth of 12 to 28 inches. Texture of the control section (between depths of 10 and 40 inches) is sandy clay loam or clay loam that is 23 to 35 percent clay.

The A horizon is grayish brown, dark grayish brown, or brown. Texture is sandy clay loam or fine sandy loam.

The B2 horizon is grayish brown, brown, light brownish gray, pale brown, or light brown. It is sandy clay loam or clay loam.

The C horizon is very pale brown, pale brown, light brownish gray, or light brown sandy clay loam or clay loam. It has few to many soft masses and concretions of calcium carbonate. Reaction is moderately alkaline or strongly alkaline.

Incell series

The Incell series consists of deep, nearly level, very poorly drained soils that have a clayey surface layer. These soils are in depressions on the low coastal terraces. The surface is concave and is usually ponded. Slopes are less than 1 percent.

Typical pedon of Incell clay; from junction of Farm Road 1420 and Texas Highway 186, 8.4 miles east on Texas Highway 186, and 0.1 mile north of road, in center of depression:

A11—0 to 6 inches; dark gray (10YR 4/1) clay, black (10YR 2/1) moist; weak fine blocky structure; hard, firm; many fine roots; neutral; abrupt smooth boundary.

A12—6 to 25 inches; dark gray (10YR 4/1) clay; black (10YR 2/1) moist; few fine faint olive mottles; weak fine subangular blocky structure; very hard, very firm; few fine roots; neutral; abrupt smooth boundary.

Cg—25 to 60 inches; light brownish gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; many fine distinct light olive brown mottles; massive; slightly hard, friable; few fine concretions of calcium carbonate and neutral salts; calcareous; moderately alkaline.

The solum and mollic epipedon range from 24 to 34 inches in thickness. Clay content of the control section (between depths of 10 and 40 inches) averages from 25 to 35 percent.

The A horizon is dark gray or very dark gray. Reaction is slightly acid or neutral.

The C horizon is grayish brown, light brownish gray, light olive gray, pale olive, or gray. Texture is sandy clay loam, clay loam, or loam. Mottles are few to many and are olive, light olive brown, yellowish brown, or dark grayish brown. The C horizon is mildly alkaline or moderately alkaline. In some pedons, it has a few specks, or concretions, of calcium carbonate.

Jarron series

The Jarron series consists of deep, nearly level, poorly drained loamy soils. These sodic soils are in depressions on low coastal terraces. The surface is concave and is frequently ponded. Slopes are less than 1 percent.

Typical pedon of Jarron sandy clay loam; from Willamar, 2.5 miles south on Farm Road 1420, 1 mile east and 0.2 mile north on county road, 0.3 mile west on oilfield road, and 100 feet south:

A1—0 to 7 inches; dark gray (10YR 4/1) sandy clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; very hard, friable; many fine roots; neutral; abrupt wavy boundary.

A2—7 to 8 inches; gray (10YR 6/1) fine sandy loam, gray (10YR 5/1) moist; few fine distinct yellowish brown mottles; massive; hard, friable; common fine roots; neutral; abrupt wavy boundary.

B21t—8 to 18 inches; gray (10YR 5/1) sandy clay, dark gray (10YR 4/1) moist; moderate coarse prismatic structure parting to weak coarse blocky; very hard, firm; few fine roots; clay films on faces of peds; saline; neutral; gradual smooth boundary.

B22t—18 to 26 inches; gray (10YR 5/1) sandy clay, dark gray (10YR 4/1) moist; weak medium prismatic structure parting to weak medium blocky; very hard, firm; a few fine concretions of calcium carbonate; saline; mildly alkaline; gradual smooth boundary.

B3ca—26 to 36 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; hard, firm; few fine black concretions; many fine and medium soft masses and concretions of calcium carbonate; saline; calcareous; moderately alkaline; gradual smooth boundary.

Cca—36 to 65 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; massive; hard, firm; many fine and medium soft masses and concretions of calcium carbonate; saline; calcareous; moderately alkaline.

Solum thickness ranges from 30 to 44 inches; sodium saturation is more than 15 percent in the Bt horizon and increases with depth.

The A1 horizon is gray, dark gray, grayish brown, or dark grayish brown. The A2 horizon is gray, light gray, or light brownish gray sandy clay loam or fine sandy loam. Reaction is slightly acid or neutral. Salinity ranges from 2 to 8 millimhos per centimeter.

The Bt horizon is gray or dark gray sandy clay, clay, or clay loam. Clay content ranges from 35 to 50 percent. Salinity ranges from 4 to 12 millimhos per centimeter. Reaction is neutral, moderately alkaline, or strongly alkaline.

The B3 horizon is grayish brown, olive gray, or brown clay loam, sandy clay, or clay. Salinity ranges from 8 to 16 millimhos per centimeter.

The C horizon is very pale brown, pale brown, or light gray sandy clay loam, clay loam, or clay. Salinity ranges from 10 to 30 millimhos per centimeter.

Lalinda series

The Lalinda series consists of deep, gently sloping, well drained loamy soils on ridges on low coastal terraces. The surface is convex. Slopes range from 1 to 5 percent.

Typical pedon of Lalinda sandy clay loam, 1 to 5 percent slopes; 24 miles east of Raymondville; from entrance to the Port Mansfield area, 1.1 miles east, on top of a ridge:

A11—0 to 3 inches; grayish brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak medium platy structure parting to granular; slightly hard, very friable; many fine roots; mildly alkaline; clear smooth boundary.

A12—3 to 6 inches; gray (10YR 5/1) sandy clay loam, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure; hard, friable; many fine roots; mildly alkaline; clear smooth boundary.

B21—6 to 21 inches; grayish brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; calcareous; moderately alkaline; clear smooth boundary.

B22—21 to 30 inches; light brownish gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; moderate medium blocky structure; hard, friable; few fine roots; few fine crystalline salts and masses of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B3—30 to 38 inches; light gray (2.5Y 7/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; slightly hard, friable; few fine roots; few fine crystalline masses and films of salt; saline; calcareous; moderately alkaline; gradual smooth boundary.

B3sa—38 to 56 inches; light gray (2.5Y 7/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; slightly hard, friable; few fine roots; many threads and films of salt below 42 inches; saline; calcareous; moderately alkaline; gradual smooth boundary.

Csa—56 to 72 inches; light gray (2.5Y 7/2) sandy clay loam, light brownish gray (2.5Y 6/2) moist; massive; slightly hard, friable; few fine roots; many threads and films of salt; saline; calcareous; moderately alkaline.

Depth to an underlying contrasting layer, or C horizon, ranges from 40 to 60 inches. Salinity in the B and C horizons increases with depth and ranges from 4 to more than 20 millimhos per centimeter. Buried A and B horizons occur in some pedons below a depth of about 20 inches. A salic horizon occurs in some pedons below a depth of 40 inches.

The A horizon is gray, dark gray, grayish brown, or dark grayish brown. It is mildly alkaline or moderately alkaline.

The B horizon is grayish brown, light gray, gray, light brownish gray, or light olive gray. The texture is sandy clay loam or clay loam. It contains few to many threads and films of crystalline salt and calcium carbonate. It is moderately alkaline or strongly alkaline.

The C horizon is light gray or white sandy clay loam, fine sandy loam, or clay loam. It is moderately alkaline or strongly alkaline.

Latina series

The Latina series consists of deep, nearly level, somewhat poorly drained loamy soils. These extremely saline soils formed in loamy sediments on low coastal terraces. The surface is plane to concave. Slopes range from 0 to 1 percent.

Typical pedon of Latina sandy clay loam; from junction of Farm Road 2209 and Texas Highway 186 near San Perlita, 10 miles east on Texas Highway 186, and 0.1 mile north, in rangeland:

A—0 to 4 inches; gray (10YR 5/1) sandy clay loam, very dark gray (10YR 3/1) moist; massive; very hard, friable; common fine roots; surface inch is light gray fine sandy loam; saline; moderately alkaline; clear smooth boundary.

B2—4 to 16 inches; gray (10YR 5/1) sandy clay loam, dark gray (10YR 4/1) moist, few fine faint olive mottles; moderate coarse prismatic structure parting to moderate medium blocky; very hard, friable; common fine roots; saline; moderately alkaline; gradual smooth boundary.

B3casa—16 to 26 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; many fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; hard, friable; few soft masses and concretions of calcium carbonate and segregated salts; saline; calcareous; moderately alkaline; gradual smooth boundary.

Ccasa—26 to 60 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; few medium prominent yellowish brown (10YR 5/6) mottles; massive; hard, friable; many soft masses of calcium carbonate and segregated salts; few black concretions, probably iron and manganese; saline; calcareous; strongly alkaline.

The solum is 20 to 36 inches thick. Depth to the water table ranges from 12 to 36 inches. Salinity ranges from 16 to 40 millimhos per centimeter in the A and B2 horizons and from 40 to more than 60 millimhos per centimeter in the B3 and C horizons. Clay content of the control section (between depths of 10 and 40 inches) averages 25 to 35 percent throughout.

The A horizon is gray, grayish brown, dark grayish brown, or dark gray.

The B2 horizon is gray, dark gray, or grayish brown sandy clay loam or clay loam. Mottles, if present, are olive, yellowish brown, or strong brown.

The B3 horizon is gray, grayish brown, or light brownish gray. It is a sandy clay loam or clay loam. Mottles are yellowish brown or strong brown. This horizon has few to many soft masses of calcium carbonate and segregated salts.

The C horizon is light brownish gray or grayish brown. It is sandy clay loam or clay loam and has mottles of yellowish brown, strong brown, reddish yellow, or olive. It has few to many soft masses and concretions of calcium carbonate, segregated salts, and black concretions, probably of iron and manganese.

Lomalta series

The Lomalta series consists of deep, nearly level, poorly drained clayey soils. These saline soils are in depressions along the Arroyo Colorado and on low coastal terraces. The surface is concave. Slopes are less than 1 percent.

Typical pedon of Lomalta clay; from junction of county line road and Farm Road 1420, 1.8 miles north on Farm Road 1420, 4 miles east on county road to gate at farm entrance, 1.5 miles east and 0.1 mile south, in a depression:

A1—0 to 12 inches; gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; weak medium blocky structure; very hard, very firm, very sticky, very plastic; strongly saline; calcareous; moderately alkaline; clear smooth boundary.

Bg—12 to 44 inches; gray (10YR 6/1) clay, dark gray (10YR 4/1) moist; moderate coarse blocky structure; very hard, very firm; intersecting slickensides; strongly saline; calcareous; moderately alkaline; gradual smooth boundary.

IIC—44 to 65 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; massive; very hard, very firm, very sticky, very plastic; few salt threads; bedding planes; strongly saline; calcareous; moderately alkaline.

Solum thickness ranges from 40 to 72 inches. The solum is moderately alkaline or strongly alkaline. Intersecting slickensides begin at 15 to 30 inches below the surface.

Salinity ranges from 12 to 20 millimhos per centimeter in the A horizon.

The IIC horizon is light brownish gray or very pale brown. It is clay, silt loam, or silty clay loam.

Lozano series

The Lozano series consists of deep, nearly level, somewhat poorly drained loamy soils. These soils are on low ridges of low coastal terraces. The surface is plane to convex. Slopes range from 0 to 2 percent.

Typical pedon of Lozano fine sandy loam; from junction of Farm Road 497 and Farm Road 1420, 0.1 mile south on Farm Road 1420, and 100 feet east, in a field:

Ap—0 to 10 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable; neutral; abrupt smooth boundary.

A1—10 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; hard, friable; neutral; abrupt smooth boundary.

B21t—16 to 24 inches; grayish brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to weak medium blocky; very hard, firm; distinct clay films on faces of peds; neutral; clear smooth boundary.

B22t—24 to 34 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; many fine distinct strong brown mottles; weak coarse prismatic structure parting to weak medium blocky; very hard, firm; distinct clay films on faces of peds; few films and threads of calcium carbonate; few soft blackish concretions, probably iron and manganese; mildly alkaline; clear smooth boundary.

B3ca—34 to 44 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; many fine faint strong brown mottles; weak medium subangular blocky structure; hard, firm; few soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—44 to 65 inches; pink (7.5YR 7/4) sandy clay loam, brown (7.5YR 5/4) moist; massive; hard, firm; few threads and films and soft masses of calcium carbonate; calcareous; moderately alkaline.

Solum thickness is 37 to 50 inches. Depth to secondary calcium carbonate ranges from 20 to 34 inches.

The A horizon is grayish brown, dark grayish brown, or dark gray. It is neutral or mildly alkaline.

The B2t horizon is grayish brown, dark grayish brown, dark gray, or brown. Mottles are yellowish brown or strong brown. Clay content ranges from 25 to 35 percent. This horizon is neutral or mildly alkaline.

The B3 horizon is brown or light brown. It is sandy clay loam or sandy loam. Mottles are strong brown or yellowish brown. This horizon is mildly alkaline or moderately alkaline.

The C horizon is pale brown, pink, or very pale brown. It is sandy clay loam or sandy loam. If present, mottles are yellowish brown or strong brown. This horizon has a few to many soft masses of calcium carbonate. It is moderately alkaline or strongly alkaline.

Lyford series

The Lyford series consists of deep, nearly level, moderately well drained loamy soils. These soils are on low coastal terraces. The surface is plane. Slopes range from 0 to 1 percent.

Typical pedon of Lyford sandy clay loam; from the junction of Farm Road 1762 and Farm Road 2209 in San Perlita, 2 miles north on Farm Road 2209; 0.3 mile north on county road and 100 feet west, in a field:

Ap—0 to 12 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, friable; neutral; clear smooth boundary.

B2t—12 to 20 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to weak medium subangular blocky; hard, firm; patchy clay films on peds; neutral; clear smooth boundary.

B3—20 to 40 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; common fine faint gray and yellowish brown mottles; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm; a few masses, specks, and films of calcium carbonate; calcareous; mildly alkaline; gradual smooth boundary.

Cca—40 to 60 inches; light brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; hard, very firm; 5 percent by volume soft masses and concretions of calcium carbonate; a few salt crystals; saline; calcareous; moderately alkaline.

The solum thickness ranges from 34 to 50 inches. Secondary carbonates occur at a depth of 20 to 36 inches.

The A horizon is dark grayish brown, dark gray, or very dark grayish brown. It is neutral or mildly alkaline.

The B2t horizon is grayish brown, dark grayish brown, dark gray, or very dark grayish brown. It is sandy clay loam or clay loam. Some pedons have few to common, faint to distinct mottles of gray and yellowish brown. Reaction is neutral or mildly alkaline.

The B3 horizon is brown, light brownish gray, pale brown, or light yellowish brown. In some pedons, there

are a few to common, faint or distinct yellowish brown or gray mottles. This horizon has few to many soft masses of calcium carbonate. It is neutral to moderately alkaline.

The C horizon is pale brown, very pale brown, light gray, light yellowish brown, or light brown. It is sandy clay loam or clay loam. It has a few to many soft masses and concretions of calcium carbonate.

Mercedes series

The Mercedes series consists of deep, nearly level, moderately well drained clayey soils. These soils are on flats of middle stream terraces. The surface is plane to slightly concave. Slopes are less than 1 percent.

Typical pedon of Mercedes clay; from junction of U.S. Highway 77 and Farm Road 498 near Lyford, 1.5 miles east on Farm Road 498, and 100 feet north, in a field:

Ap—0 to 12 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate fine subangular blocky structure; hard, firm; sticky and plastic; few snail shell fragments; calcareous; moderately alkaline; abrupt smooth boundary.

A1—12 to 48 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate medium angular blocky structure; very hard, very firm, very plastic and sticky; many intersecting slickensides; a few snail shell fragments; calcareous; moderately alkaline; diffuse smooth boundary.

AC—48 to 60 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; weak medium angular blocky structure; very hard, very firm, very plastic and sticky; slickensides; saline; calcareous; strongly alkaline; clear smooth boundary.

C—60 to 80 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; massive; hard, firm, plastic and sticky; few salt crystals and concretions of calcium carbonate; saline; calcareous; strongly alkaline.

The solum ranges from 44 to 72 inches in thickness. Intersecting slickensides begin at a depth of 10 to 30 inches. Clay content of the 10- to 40-inch layer is 45 to 60 percent. The solum is moderately to strongly alkaline throughout.

The A horizon is gray or light gray.

The AC horizon is light brownish gray or pale brown.

The C horizon is pale brown, very pale brown, or brown. It has a few concretions of calcium carbonate and crystals of salt. The exchangeable sodium percentage ranges from 15 to 30.

Mustang series

The Mustang series consists of deep, nearly level, poorly drained sandy soils in depressions on low coastal terraces and Padre Island. The surface is plane to concave. Slopes range from 0 to 1 percent.

Typical pedon of Mustang fine sand; from the beach at the south county line on south Padre Island, 0.5 mile north and 0.25 mile west:

A—0 to 8 inches; light brownish gray (2.5Y 6/2) fine sand, grayish brown (2.5Y 5/2) moist; single grained; loose, very friable; many fine roots; many sand-sized fragments of shell; calcareous; moderately alkaline; clear smooth boundary.

Cg—8 to 60 inches; light gray (2.5Y 7/2) fine sand, light brownish gray (2.5Y 6/2) moist; many fine distinct light olive brown (2.5Y 5/4) mottles; massive; soft, very friable; calcareous; moderately alkaline.

Reaction throughout is mildly alkaline or moderately alkaline.

The A horizon is light brownish gray, grayish brown, light gray, or gray.

The Cg horizon is light gray or white. Texture is sand, fine sand, or loamy fine sand. Mottles are yellowish brown, strong brown, light olive brown, or dark brown.

Nueces series

The Nueces series consists of deep, nearly level, moderately well drained sandy soils. These soils are on the eolian sand sheet. The surface is plane. Slopes range from 0 to 3 percent.

Typical pedon of Nueces fine sand; from the junction of U.S. Highway 77 and the north county line, 1.5 miles west:

A11—0 to 22 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; single grained; loose; common fine roots: neutral; clear smooth boundary.

A12—22 to 29 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; few fine faint strong brown mottles; single grained; loose; common fine roots; neutral; abrupt smooth boundary.

B21t—29 to 32 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; few medium distinct yellowish brown mottles; massive; hard, friable; common fine roots; neutral; clear smooth boundary.

B22t—32 to 39 inches; light brownish gray (2.5Y 6/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; few fine distinct light olive brown mottles; moderate coarse prismatic structure parting to moderate medium blocky; very hard, firm; few fine roots; continuous dark grayish brown clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B23t—39 to 48 inches; light gray (2.5Y 7/2) sandy clay loam, light brownish gray (2.5Y 6/2) moist; many medium prominent olive yellow mottles; moderate coarse prismatic structure parting to moderate medium blocky; very hard, firm; continuous clay films on faces of peds; moderately alkaline; gradual smooth boundary.

B3—48 to 58 inches; pale yellow (2.5Y 7/4) sandy clay loam, light yellowish brown (2.5Y 6/4) moist; few fine distinct olive yellow mottles; weak medium blocky structure; hard, firm; continuous clay films on faces of peds; moderately alkaline; gradual smooth boundary.

B3ca—58 to 76 inches; yellow (2.5Y 7/6) sandy clay loam, olive yellow (2.5Y 6/6) moist; few fine faint yellowish brown mottles; weak medium blocky structure; hard, firm; few durinodes; few films of calcium carbonate and salt; calcareous; moderately alkaline.

Solum thickness is 60 to more than 80 inches.

The A horizon is 20 to 40 inches thick. It is grayish brown, light brownish gray, pale brown, or very pale brown. Reaction is slightly acid or neutral. A few faint to distinct strong brown or yellowish brown mottles are in the lower part.

The B2t horizon is grayish brown, light brownish gray, or light gray with few to many brownish, yellowish, or reddish mottles. It is slightly acid to moderately alkaline.

The B3 horizon is yellow, pale yellow, or very pale brown with few to many yellowish brown mottles.

Porfirio series

The Porfirio series consists of deep, nearly level, somewhat poorly drained loamy saline soils that are on low coastal terraces. The surface is plane. Slopes are 0 to 1 percent.

Typical pedon of Porfirio sandy clay loam; from junction of Farm Road 1420 and south level of the North Floodway, 8 miles east on south levee, and 0.1 mile south, in a cultivated field:

Ap—0 to 12 inches; dark gray (10YR 4/1) sandy clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; hard, friable; moderately saline; calcareous; moderately alkaline; clear smooth boundary.

B21ca—12 to 20 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate fine blocky; hard, firm; many soft masses of calcium carbonate; moderately saline; calcareous; moderately alkaline; gradual smooth boundary.

B22ca—20 to 36 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; few medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine blocky; hard, firm; many soft masses of calcium carbonate; strongly saline; calcareous; moderately alkaline; gradual smooth boundary.

C1sa—36 to 48 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; few medium distinct yellowish brown (10YR 5/6) mottles; massive; hard, firm; about 20 percent by volume soft masses and concretions of calcium carbonate and other crystalline salts; strongly saline; calcareous; strongly alkaline; gradual smooth boundary.

C2sa—48 to 65 inches; pinkish gray (7.5YR 7/2) clay loam, pinkish gray (7.5YR 6/2) moist; many coarse prominent yellowish brown (10YR 5/6) mottles; massive; hard, firm; few fine concretions of calcium carbonate and other crystalline salts; strongly saline; calcareous; strongly alkaline.

Solum thickness ranges from 28 to 42 inches. Depth to secondary carbonates ranges from 8 to 20 inches. Depth to mottling is 10 to 28 inches, and the amount and distinctness increase with depth. Reaction is moderately alkaline or strongly alkaline.

The A horizon is gray, dark gray, very dark grayish brown, dark grayish brown, or grayish brown. Salinity ranges from 4 to 8 millimhos per centimeter.

The B2 horizon is grayish brown, light brownish gray, or brown clay loam, sandy clay, or clay. Clay content ranges from 35 to 45 percent. Mottles are few to many, fine to medium, faint to distinct and yellowish brown, brownish yellow, and dark yellowish brown. Salinity ranges from 6 to about 12 millimhos per centimeter.

The C horizon is pinkish gray, pale brown, light gray, or very pale brown. It is clay loam, clay, sandy clay, or sandy clay loam. Mottles are few to many, medium to large, distinct to prominent in shades of yellow and brown. Salinity ranges from 12 to about 100 millimhos per centimeter.

Racombes series

The Racombes series consists of deep, nearly level, moderately well drained loamy soils. These soils are on drainageways of middle stream terraces. The surface is plane to concave. Slopes range from 0 to 1 percent.

Typical pedon of Racombes sandy clay loam; from junction of Spur 56 and U.S. Highway 77 south of Raymondville, 0.5 mile south on U.S. Highway 77, 0.25 mile east, 0.1 mile south on a county road, and 100 feet east, in a field:

Ap—0 to 10 inches; dark gray (10YR 4/1) sandy clay loam, black (10YR 2/1) moist; moderate fine subangular blocky structure parting to fine granular; hard, friable; mildly alkaline; clear smooth boundary.

B21t—10 to 20 inches; dark gray (10YR 4/1) sandy clay loam, very dark gray (10YR 3/1) moist; moderate prismatic structure parting to weak medium blocky; hard, firm; thick clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B22t—20 to 32 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; patchy clay films on faces of ped; mildly alkaline; clear smooth boundary.

B3—32 to 44 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; few fine faint strong brown mottles; weak medium subangular blocky structure; slightly hard, firm; many dark gray films; moderately alkaline; gradual smooth boundary.

Cca—44 to 60 inches; pink (7.5YR 7/4) clay loam, brown (7.5YR 5/4) moist; massive; slightly hard, firm; few gray films; 10 percent by volume soft masses of calcium carbonate; calcareous; moderately alkaline.

Solum thickness is 40 to 60 inches. Depth to secondary carbonates is 24 to 49 inches. The mollic epipedon is 20 to 44 inches thick. Clay content of the upper 20 inches of the Bt horizon ranges from 26 to 34 percent.

The A horizon is dark gray or very dark gray. It is mildly alkaline or neutral.

The upper part of the Bt horizon is dark gray, dark grayish brown, dark brown, or grayish brown. It is mildly alkaline or neutral. The lower part of the Bt horizon is dark grayish brown, pinkish gray, brown, or grayish brown sandy clay loam or clay loam. It is mildly alkaline or moderately alkaline. Some pedons have a few threads and films of calcium carbonate in the lower part of the Bt horizon.

The B3 horizon is light brown, light brownish gray, or brown sandy clay loam or clay loam. It has a few threads and films of calcium carbonate in some pedons.

The C horizon is pink or pale brown sandy clay loam or clay loam that is as much as 15 percent by volume concretions and masses of calcium carbonate.

Raymondville series

The Raymondville series consists of deep, nearly level, moderately well drained clayey soils. These calcareous soils are on flats of middle stream terraces. The surface is plane to slightly depressed. Slopes range from 0 to 1 percent.

Typical pedon of Raymondville clay loam; from junction of Texas Highway 186 and Farm Road 1761, 0.8 mile west on Texas Highway 186, 0.3 mile north on county road, and 0.2 mile west of road:

Ap—0 to 8 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky and granular structure; slightly hard, friable; a few fragments of snail shells; calcareous; moderately alkaline; clear smooth boundary.

A1—8 to 16 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; a few snail shell fragments; a few fine specks and films of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B21ca—16 to 46 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; few faint very fine light gray mottles; moderate fine angular blocky structure; hard, firm; a few fragments of snail shells; a few dark gray films and streaks; many threads, films, and soft masses of calcium carbonate in lower 12 inches; calcareous; moderately alkaline; gradual smooth boundary.

C1ca—46 to 60 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; massive; hard, firm; a few snail shell fragments; a few soft masses of calcium carbonate, threads, and films and other segregated salts; saline; calcareous; moderately alkaline.

Solum thickness is 32 to 46 inches. Depth to a calcic horizon is 24 to 40 inches. Snail shells are common in most pedons. A seasonal water table at a depth of 3 to 4 feet occurs in some pedons in irrigated areas. The clay content of the 10- to 40-inch layer ranges from 36 to 55 percent. When dry, these soils have cracks 1 centimeter or more wide in the upper part of the subsoil.

The A horizon is gray, dark gray, grayish brown, or dark grayish brown.

The B2 horizon is light brownish gray, grayish brown, pale brown, or brown clay loam or clay. This horizon contains few to many fine masses, threads, and films of calcium carbonate.

The C horizon is very pale brown, pale brown, or light brownish clay loam or clay. It has 1 to 15 percent by volume masses and concretions of calcium carbonate. Some pedons have gypsum crystals and other segregated salts.

Rio series

The Rio series consists of deep, nearly level, somewhat poorly drained loamy soils. These soils are in depressions on middle stream terraces. The surface is concave. Slopes range from 0 to 1 percent.

Typical pedon of Rio sandy clay loam, from junction of Farm Road 1015 and Texas Highway 186 north of Lasara, 0.5 mile west on Texas Highway 186, 1.7 miles north on county road, 0.1 mile west on farm road, and 50 feet north in a field:

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure parting to fine granular; hard, friable; neutral; clear smooth boundary.

A1—5 to 10 inches; grayish brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, friable; neutral; abrupt smooth boundary.

B2t—10 to 26 inches; dark gray (10YR 4/1) clay, black (10YR 2/1) moist; moderate medium prismatic structure parting to moderate medium blocky; very hard, very firm; clay films on faces of peds; few fine black concretions, probably iron and manganese; mildly alkaline; gradual wavy boundary.

B3—26 to 44 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; few fine distinct yellowish brown mottles; weak medium blocky structure; hard, firm; few fine black concretions, probably iron and manganese; few specks and films of calcium carbonate; moderately alkaline; gradual wavy boundary.

C1—44 to 65 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; massive; hard, firm; few soft bodies and concretions of calcium carbonate; moderately alkaline; calcareous.

Solum thickness is 40 to 70 inches. Salinity of the surface layer ranges from 0.5 to 12 millimhos per centimeter and generally increases with depth.

The A horizon is gray, dark gray, grayish brown, or dark grayish brown. Texture is sandy clay loam or fine sandy loam. Reaction is neutral or mildly alkaline.

The Bt horizon is gray, dark gray, or grayish brown. Reaction is mildly alkaline or moderately alkaline, and texture is clay or clay loam that has 35 to 50 percent clay. Some pedons have brownish yellow, strong brown, or olive yellow mottles.

The B3 horizon is light brownish gray, grayish brown, or gray. Texture is clay or clay loam. Reaction is moderately alkaline or strongly alkaline. Mottles are yellowish brown, pale olive, or dark brown.

The C horizon is pale brown, very pale brown, or light brownish gray. Texture is clay loam or sandy clay loam.

Sarita series

The Sarita series consists of deep, gently undulating, well drained sandy soils on the eolian sand sheet. Slopes range from 1 to 5 percent.

Typical pedon of Sarita fine sand, gently undulating; from the junction of Texas Highway 186 and U.S. Highway 77 in Raymondville, 5.25 miles north on U.S. Highway 77, 0.5 mile west to a range headquarters, 0.5 mile south on ranch road. and 0.2 mile west, in rangeland:

A1—0 to 30 inches; brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; single grained; loose, very friable; many fine roots in the upper 12 inches, common fine roots below; neutral; clear smooth boundary.

A2—30 to 50 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; few fine distinct yellowish brown (10YR 5/4) mottles; single grained; loose, very friable; few fine roots; neutral; abrupt smooth boundary.

B21t—50 to 55 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; many medium distinct yellowish brown (10YR 5/4) mottles; moderate coarse prismatic structure; extremely hard, very firm; continuous clay films on vertical ped faces; neutral; clear smooth boundary.

B22t—55 to 70 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; many medium and coarse prominent red (2.5YR 5/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; hard, firm; common clay films on vertical ped faces; mildly alkaline; clear smooth boundary.

B3—70 to 80 inches; very pale brown (10YR 7/4) sandy clay loam, pale olive (5Y 6/3) moist; few fine distinct red (2.5YR 5/6) mottles; weak fine subangular blocky structure; hard, firm; moderately alkaline.

Solum thickness is more than 80 inches. Reaction is slightly acid or neutral in the upper part and medium acid to moderately alkaline in the lower part.

The A1 horizon is grayish brown, light brownish gray, or brown. The A2 horizon is pale brown, light gray, very pale brown, or light brown

The B2t horizon is light brownish gray, light gray, pale brown, or brown with reddish and brownish mottles.

The B3 horizon is light yellowish brown, light gray, or very pale brown. It is calcareous or noncalcareous.

Satatton series

The Satatton series consists of deep, nearly level, poorly drained sandy soils. These extremely saline soils are on flats of low coastal terraces on Padre Island. Elevation is 1 to 3 feet above mean sea level. The surface is plane. Slopes range from 0 to 1 percent.

Typical pedon of Satatton fine sand; from Port Mansfield channel on the gulf beach, 3 miles south and 0.3 mile west:

Asa—0 to 6 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; few dark gray (N 4/0) lenses; massive and vesicular; upper 2 inches weakly cemented by salt; soft, very friable below 2 inches; about 10 percent by volume soluble salts; extremely saline; calcareous; strongly alkaline; clear smooth boundary.

C1gsa—6 to 16 inches; light gray (2.5Y 7/2) fine sand, grayish brown (2.5Y 5/2) moist, with many fine distinct brown (7.5YR 5/4) mottles; massive; very friable; about 22 percent soluble salts; extremely saline; calcareous; strongly alkaline; clear smooth boundary.

C2gsa—16 to 60 inches; light gray (2.5Y 7/2) fine sand, light brownish gray (2.5Y 6/2) moist; common fine and medium distinct dark gray (N 4/0) and yellowish brown (10YR 5/6) mottles; massive; very friable; about 20 percent soluble salts; extremely saline; calcareous; strongly alkaline.

Salinity ranges from 60 to 400 millimhos per centimeter.

The Asa horizon is light brownish gray, pale brown, or brown when moist. The upper 1/2 inch to 4 inches is weakly cemented with salt in many pedons most of the year but has a loose consistence after inundation.

The C1gsa horizon is grayish brown or light brownish gray when moist. Mottles are few to many fine or medium faint or distinct yellowish brown, strong brown, brown, light olive brown, dark gray, and very dark gray.

The C2gsa horizon is grayish brown, light brownish gray, light olive gray, very dark gray, dark gray, or pale brown when moist. Color of the C2gsa horizon changes with the seasonal encroachment or downward regression of the ground water. Neutral colors occur mostly from the capillary fringe downward. In some pedons, sand-sized particles of shell make up to 5 percent of the volume.

Saucel series

The Saucel series consists of deep, nearly level, poorly drained loamy soils. These are extremely saline soils on low coastal terraces. The surface is plane. Slopes range from 0 to 1 percent.

Typical pedon of Saucel sandy loam; from the entrance to the Port Mansfield area, 0.5 mile east of entrance on Texas Highway 497, 1 mile north on dirt road, and 0.1 mile west of road:

Asa—0 to 4 inches; light brownish gray (2.5Y 6/2) sandy loam, grayish brown (10YR 5/2) moist; weak fine platy structure; slightly hard, friable; many fine roots; extremely saline; calcareous; strongly alkaline; abrupt wavy boundary.

B21sa—4 to 17 inches; light gray (2.5Y 7/2) sandy loam, grayish brown (2.5Y 5/2) moist; few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; hard, friable; common fine roots; few fine salt crystals; extremely saline; calcareous; strongly alkaline; gradual smooth boundary.

B22sa—17 to 34 inches; light gray (2.5Y 7/2) sandy loam, light brownish gray (2.5Y 6/2) moist; common fine distinct dark brown (7.5YR 3/2) mottles; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable; few fine roots; common fine salt crystals; extremely saline; calcareous; strongly alkaline; gradual smooth boundary.

B3gsa—34 to 44 inches; light gray (5Y 7/2) sandy loam, gray (5Y 5/1) moist; weak medium subangular blocky structure; hard, friable; extremely saline; calcareous; strongly alkaline; gradual smooth boundary.

IICgsa—44 to 52 inches; gray (5YR 5/1) loamy sand, dark gray (5Y 4/1) moist; massive; slightly hard, friable; extremely saline; calcareous; strongly alkaline; clear smooth boundary.

IIICgsa—52 to 62 inches; light olive gray (5Y 6/2) sandy clay loam, olive gray (5Y 5/2) moist; many coarse prominent light olive brown (2.5Y 5/4) mottles; massive; very hard, firm; few crystalline salt masses; few concretions of calcium carbonate; extremely saline; calcareous; strongly alkaline.

Solum thickness is 34 to 50 inches. Salinity ranges from 16 to more than 70 millimhos per centimeter. Salinity increases or remains about constant with depth. Reaction is moderately alkaline or strongly alkaline.

The Asa horizon is grayish brown, dark grayish brown, olive gray, or gray when moist.

The B horizon is sandy loam that is 10 to 17 percent clay. The B21sa horizon has colors similar to those in the Asa horizon, but it has few to common, faint to distinct brownish and yellowish mottles. The B22sa horizon is light brownish gray, light olive brown, or gray when moist. When it is dry, colors are one or two units higher in value. The B22sa horizon has few to many, faint to distinct grayish and brownish mottles.

The IIC horizon, C horizon, and other contrasting layers in some pedons are dark gray, gray, grayish brown, dark grayish brown, light olive gray, or olive gray when moist. Mottles are fine to coarse, prominent or distinct, and grayish, yellowish, and brownish. Texture is loamy sand, fine sandy loam, or sandy clay loam. There are few to many concretions and soft masses of calcium carbonate and other salts.

Sauz series

The Sauz series consists of deep, nearly level, somewhat poorly drained sandy soils. These are sodic soils on low coastal terraces. The surface is plane to slightly convex. Slopes range from 0 to 2 percent.

Typical pedon of Sauz loamy fine sand; from intersection of Interstate Highway 77 and Texas Highway 186 in Raymondville, 24 miles east on Texas Highway 186 and Farm Road 197 to the Port Mansfield area, and

0.1 mile south of highway in the southeast corner of the Port Mansfield area:

A1—0 to 7 inches; light brownish gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; many fine roots; slightly saline; mildly alkaline; abrupt smooth boundary.

B21t—7 to 13 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; few fine distinct yellowish brownish mottles inside peds; strong coarse columnar structure parting to moderate coarse blocky; very hard, firm; common fine roots; distinct light gray rounded cap about 3 millimeters thick on top of the columns; continuous dark gray clay films and patches of light gray clean sand grains on faces of peds; moderately saline; strongly alkaline; clear smooth boundary.

B22t—13 to 24 inches; light brownish gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; moderate coarse prismatic structure parting to moderate coarse blocky; hard, friable; common fine roots; continuous gray clay films on faces of peds; moderately saline; strongly alkaline; gradual smooth boundary.

B23tcasa—24 to 40 inches; light brownish gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; common fine roots; few fine salt crystals; few soft masses of calcium carbonate and other salts; strongly saline; calcareous; strongly alkaline; gradual smooth boundary.

B3casa—40 to 55 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; many medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; slightly hard, friable; few fine roots; many fine salt crystals and concretions of calcium carbonate; strongly saline; calcareous; strongly alkaline; gradual smooth boundary.

Cgsa—55 to 65 inches; gray (5Y 6/1) fine sandy loam, gray (5Y 5/1) moist; many medium prominent yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable; few fine salt crystals; strongly saline; calcareous; strongly alkaline.

Solum thickness ranges from 40 to 60 inches. Depth to secondary carbonates ranges from 20 to 36 inches. Clay content of the upper 20 inches of the Bt horizon ranges from 10 to 18 percent. Sodium saturation is more than 15 percent in the B and C horizons and increases with depth. Reaction is mildly alkaline or neutral in the A horizon and moderately alkaline or strongly alkaline in the B and C horizons.

The A horizon is light brownish gray, light gray, or grayish brown fine sand or loamy fine sand. Salinity ranges from 2 to 4 millimhos per centimeter.

The Bt horizon is grayish brown, gray, or light brownish gray. Texture is fine sandy loam, sandy loam, or sandy clay loam that has few to many brownish or yellowish mottles. Salinity ranges from 2 to 16 millimhos per centimeter.

The B3 horizon is light brownish gray, grayish brown, gray, and light gray sandy clay loam, fine sandy loam, or sandy loam with few to many brownish or yellowish mottles. It has few to many, soft masses and concretions of calcium carbonates and other salts. Salinity ranges from 8 to 16 millimhos per centimeter.

The C horizon or IIC horizon is light gray, gray, light brownish gray, or light olive gray sandy clay loam or fine sandy loam with few to many yellowish or brownish mottles. Salinity ranges from 8 to 30 millimhos per centimeter.

Tatton series

The Tatton series consists of deep, level, very poorly drained sandy soils. These extremely saline soils are on tidal flats on low coastal terraces. Ponding by seawater occurs for several weeks during the year, mainly in the winter months. The surface is plane. Slopes range from 0 to 1 percent.

Typical pedon of Tatton fine sand; from Deer Island in the southeastern part of the county, the site is 0.5 mile west and 0.5 mile north of the south county line:

A—0 to 5 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; single grained; loose; coherent algae crust 1/2 inch thick on surface; extremely saline; calcareous; moderately alkaline; abrupt smooth boundary.

C1g—5 to 12 inches; gray (10YR 6/1) loamy fine sand, gray (10YR 6/1) moist; massive; soft, very friable; extremely saline; calcareous; moderately alkaline; clear smooth boundary.

C2g—12 to 60 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; single grained; loose; a few soft shell fragments; extremely saline; calcareous; strongly alkaline.

Salinity is more than 16 millimhos per centimeter. The sodium absorption ratio is greater than 13, and the exchangeable sodium percentage is more than 15. These soils are moderately or strongly alkaline throughout. Many pedons have a surface layer 3 to 12 inches thick that contains thin strata of loamy and clayey materials, probably deposited during the dredging of the Intracoastal Waterway in Laguna Madre.

The A horizon is light gray or gray fine sand or loamy fine sand. The upper 0.5 inch to 2 inches is coherent due to growth of a blue-green mat-forming algae. Growth of the algae is most active during inundation.

The Cg horizon is light gray or gray fine sand or loamy fine sand.

Tiocano series

The Tiocano series consists of deep, nearly level, somewhat poorly drained clayey soils. These are seasonally wet soils in depressions on stream terraces. The surface is concave and is ponded during wet periods. Slopes are less than 1 percent.

Typical pedon of Tiocano clay; from junction of U.S. Highway 77 and Texas Highway 186 in Raymondville, 17 miles west on Texas Highway 186, and 0.25 mile south of highway, in a depression:

A1—0 to 10 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium blocky structure; very hard, very firm, sticky and plastic; neutral; clear smooth boundary.

A12—10 to 44 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium and coarse blocky structure; very hard, very firm, sticky and plastic; distinct slickensides; mildly alkaline; gradual smooth boundary.

ACca—44 to 59 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; few fine distinct brown (7.5YR 5/4) mottles; weak medium blocky structure; very hard, very firm, sticky and plastic; distinct intersecting slickensides; few concretions of calcium carbonate; moderately alkaline; calcareous; clear smooth boundary.

Cg—59 to 70 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; few fine distinct strong brown (7.5YR 5/6) mottles; massive; hard, firm, plastic and sticky; many dark gray films; few concretions of calcium carbonate; moderately alkaline; noncalcareous.

Solum thickness is 40 to 60 inches. The soil is neutral to moderately alkaline throughout. When dry, it has cracks 1/2 to 3 inches wide that extend to a depth of 30 to 40 inches. The clay content of the 10- to 40-inch control section ranges from 40 to 60 percent.

The A horizon is gray, dark gray, or very dark gray.

The AC horizon is dark gray, gray, or grayish brown. Some pedons have a few concretions of calcium carbonate and a few black concretions, probably iron and manganese.

The C horizon is light brownish gray or gray clay or clay loam. It has few to many concretions and soft masses of calcium carbonate.

Willacy series

The Willacy series consists of deep, nearly level and gently sloping, well drained loamy soils on ridges of middle stream terraces. The surface is convex. Slopes range from 0 to 3 percent.

Typical pedon of Willacy fine sandy loam, 0 to 1 percent slopes; 200 feet west and 100 feet north from the west junction of Farm Road 498 and Farm Road 2055:

Ap—0 to 14 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky and granular structure; slightly hard, very friable; many fine roots; neutral; abrupt smooth boundary.

B21t—14 to 18 inches; grayish brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; common fine roots; mildly alkaline; gradual smooth boundary.

B22t—18 to 36 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to weak medium subangular blocky; hard, friable; prominent clay films on ped faces; mildly alkaline; clear smooth boundary.

B3—36 to 44 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable; few threads and films of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

Cca—44 to 65 inches; very pale brown (10YR 7/3) sandy clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable; many soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Solum thickness ranges from 40 to 60 inches. Secondary calcium carbonate occurs at 36 to 50 inches below the surface.

The A horizon is grayish brown, dark grayish brown, or very dark grayish brown. It is neutral or mildly alkaline.

The B2t horizon is grayish brown, dark grayish brown, or brown. The clay content ranges from 18 to 27 percent. This horizon is neutral or mildly alkaline.

The B3 horizon is brown or pale brown. It is neutral to moderately alkaline. Most pedons have a few films, masses, and concretions of calcium carbonate.

The C horizon is very pale brown or pale brown. Texture is sandy loam or sandy clay loam. This horizon has up to about 15 percent by volume soft masses and concretions of calcium carbonate.

Willamar series

The Willamar series consists of deep, nearly level, somewhat poorly drained loamy soils. These are saline-sodic soils on low areas of the low coastal terraces that have a seasonal high water table. The surface is plane to slightly concave. Slopes are less than 1 percent.

Typical pedon of Willamar fine sandy loam (fig. 11); from the junction of Farm Road 1420 and the south levee road of the North Floodway, 4.6 miles east on the south levee road, 0.1 mile south, in a pasture:

A1—0 to 3 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

A2—3 to 6 inches; gray (10YR 6/1) fine sandy loam, dark gray (10YR 4/1) moist; few fine faint yellowish brown mottles; massive; slightly hard, friable; neutral; abrupt smooth boundary.

B21t—6 to 9 inches; gray (10YR 5/1) sandy clay loam, dark gray (10YR 4/1) moist; few fine faint strong brown mottles; moderate medium prismatic structure; very hard, firm; moderately alkaline; clear smooth boundary.

B22t—9 to 15 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; few fine faint strong brown mottles; moderate medium prismatic structure parting to weak medium blocky; very hard, firm; few soft masses and concretions of calcium carbonate in the lower part; moderately alkaline; clear smooth boundary.

B3ca—15 to 28 inches; grayish brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; few fine faint strong brown mottles; weak medium angular blocky structure; hard, friable; many soft masses and concretions of calcium carbonate; slightly saline; calcareous; strongly alkaline; gradual smooth boundary.

C1casa—28 to 44 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; few fine faint strong brown mottles; massive; hard, firm; many soft masses of calcium carbonate and salt; few salt crystals; strongly saline; calcareous; strongly alkaline; gradual smooth boundary.

C2casa—44 to 65 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; many fine distinct strong brown mottles; massive; hard, firm; many soft masses of calcium carbonate and salt; few salt crystals; strongly saline; calcareous; strongly alkaline.

The solum ranges from 20 to 38 inches in thickness. Sodium saturation is more than 15 percent in the B and C horizons and increases with depth.

The A1 horizon is grayish brown, dark grayish brown, very dark grayish brown, or dark gray. Reaction is neutral or mildly alkaline. The A2 horizon is gray, light gray, or light brownish gray. In cultivated areas, the Ap horizon is a mixture of the A and B horizons.

The B2t horizon is gray, dark grayish brown, dark gray, or grayish brown. Texture is sandy clay loam or clay loam. The clay content ranges from 25 to 35 percent.

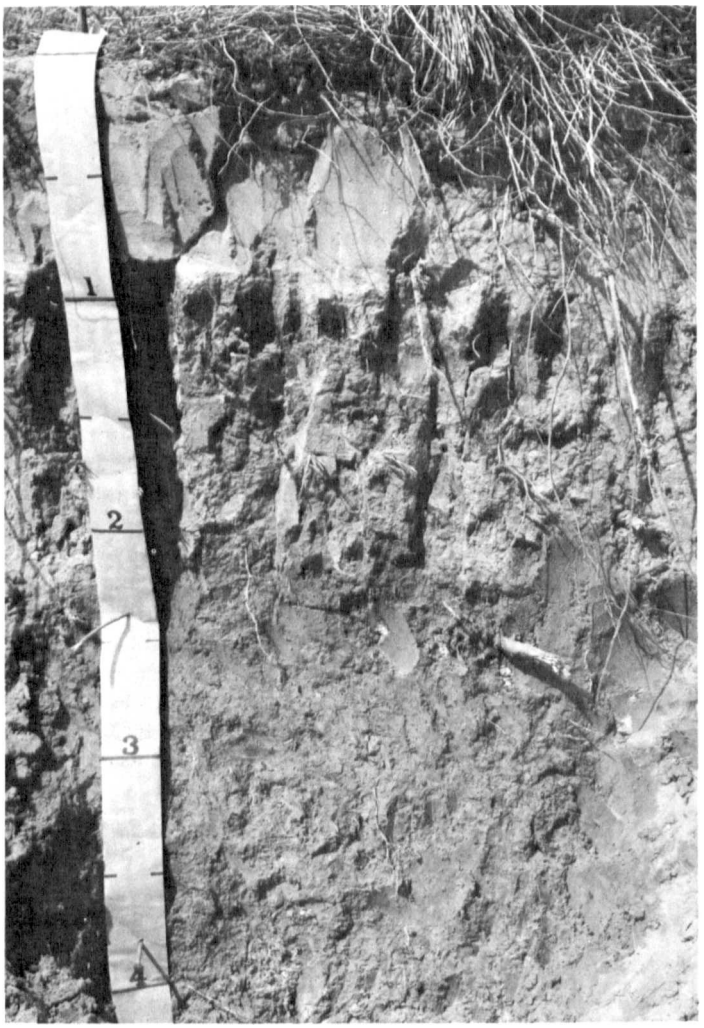


Figure 11.—Profile of Willamar fine sandy loam. This soil has a natric horizon with prismatic structure beginning at a depth of 1 foot. Depth is shown in feet.

This horizon is moderately alkaline or strongly alkaline.

The B3 horizon is grayish brown, gray, or brown sandy clay loam or clay loam. It has a few to many soft masses and concretions of calcium carbonate and segregated salts. It is moderately alkaline or strongly alkaline.

The C horizon is very pale brown or pale brown. It is sandy clay loam or clay loam. It has up to 30 percent by volume soft masses and concretions of calcium carbonate and segregated salts. Reaction is moderately alkaline or strongly alkaline.

Yturria series

The Yturria series consists of deep, gently sloping, well drained loamy soils on ridges of high stream

terraces that are modified by wind. The surface is convex. Slopes range from 1 to 5 percent.

Typical pedon of Yturria fine sandy loam; 11 miles west of Raymondville, 0.5 mile west on Texas Highway 186 from junction of Texas Highway 88, 3.1 miles north on the county road, 0.1 mile east, and 100 feet south of a fence:

Ap—0 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, friable; many fine roots; neutral; clear smooth boundary.

A1—8 to 26 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular and subangular blocky structure; slightly hard, friable; common fine roots; mildly alkaline; gradual smooth boundary.

B2ca—26 to 44 inches; light brownish gray (10YR 6/2) fine sandy loam; dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; slightly hard, friable; few fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—44 to 65 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, friable; many fine soft masses of calcium carbonate; calcareous; moderately alkaline.

Solum thickness ranges from 36 to 60 inches. Depth to secondary carbonates ranges from 24 to 36 inches.

The A horizon is grayish brown, dark grayish brown, or very dark grayish brown. It is neutral or mildly alkaline.

The B2 horizon is light brownish gray, pale brown, or brown fine sandy loam or loam. It is neutral to moderately alkaline. Some pedons have a few soft masses of calcium carbonates in this horizon.

The C horizon is very pale brown, pinkish gray, pale brown, light brown, or light gray fine sandy loam or loam. It has few to many soft masses and concretions of calcium carbonate.

Formation of the soils

Soil is formed by the action and interaction of the five major soil-forming factors. These factors are climate, living organisms (especially vegetation), parent material, relief, and time. The kind of soil that develops in a given area is determined by these factors, although the effect of any one factor is sometimes difficult to isolate.

Parent material

Parent material is the unconsolidated mass from which a soil is formed, and it determines the limits of the chemical and mineral composition of the soil. In Willacy County most of the soils formed in fluviatile sediments from freshwater and marine sources, although the northern part is the eolian sand sheet. This sand sheet probably was formed by sediments blown inland when the recession of the Gulf of Mexico exposed the Continental Shelf in some ancient time. The geology of the parent material is discussed in more detail in the section "Surface geology."

Climate

Rainfall, temperature, humidity, and wind have been important in the formation of soils in Willacy County. The more moist climate and changes in sea level of past geologic ages influenced the deposition of alluvial parent materials. Later, as rainfall decreased, the soil was seldom wet below the root zone. As a result, calcium carbonate (lime) accumulated in many of the soils, such as Hidalgo, Mercedes, and Raymondville. Therefore, many of the soils are calcareous throughout the profile due to a lack of downward movement of water. Annual rainfall for the county ranges from 24 inches in the west to 28 inches in the east. Therefore, soils in the eastern part of the county, such as Delfina, Hargill, and Willacy, generally have less lime in their surface layer and have more horizon development in the lower part of the profile than other soils in the county.

Gulf winds, predominantly from the southeast, have occasionally reworked and rearranged the soils. The sand sheet in the northern part of Willacy County is made up of eolian material that overlies ancient sediments.

Severe tropical storms with strong winds can alter the dunes on Padre Island. They cause flooding and long periods of wetness for some of the lower lying soils, such as Arrada, Barrada, Mustang, Tatton, and Satatton. During dry periods, the saline soils are especially susceptible to blowing, which has apparently caused the many ridges and depressions in the survey area.

Living organisms

Plants and animals are important in the formation of soils. They affect the amount of organic matter, nitrogen, and other plant nutrients in the soil and the structure and porosity of the soil.

Vegetation, predominantly grass, affects soil formation in Willacy County more than any other biological modifier. Mid and tall grasses contribute a large amount of organic matter to the soil. The network of roots leaves channels and pores that provide passageways for intake of air and water.

Earthworms, insects, and burrowing animals mix soil material and help the downward movement of air, water, and plant roots in the soil. Bacteria and fungi break down organic matter, which improves the fertility and tilth of soils.

The influence of man considerably affects the soils of this county. By tillage and the use of heavy machinery, he compacts the soil and reduces aeration and infiltration of water. Many areas have been considerably altered by land leveling, and in some areas, the neutral soil horizons have been completely destroyed. Man has increased the moisture supply by irrigation and has installed drainage systems to make the land more productive.

Relief

Relief affects soil formation through its influence on drainage, erosion, and plant cover. Willacy County is on nearly level stream and coastal terraces where slopes are generally less than 1 percent. The degree of development of a soil profile depends on the amount of water that enters the soil, provided other factors of soil formation are equal. Although slope is generally less than 1 percent, there is enough relief in the higher areas that well drained soils with well developed profiles have formed.

Time

The characteristics of a soil are determined mainly by the length of time that the soil-forming factors have been

active. Several thousand years are usually required for the formation of well-defined, genetically related horizons. There are differences in the age of the soils of Willacy County that can be noted from the appearance of the profile.

Soils along the coastal areas, such as Galveston, Mustang, and Barrada soils, have little profile development and are considered young. They were deposited by water or wind in recent times.

Soils of the Delfina and Willacy series, which formed in sediments of the Pleistocene epoch, have been in place long enough to develop some genetic profile characteristics. They have lost free lime from the upper part of the profile, and clay particles have moved downward and accumulated in the subsoil.

Surface geology

By Saul Aronow, Department of Geology, Lamar University, Beaumont, Texas.

Willacy County is in the West Gulf Coastal plain section of the Coastal Plain geomorphic province, in which the geologic formations crop out in gulf-paralleling bands and dip gently gulfward (*7*). The parent materials of the soils range from the Holocene eolian, coastal, and fluviatile deposits, which are less than 12,000 years old, to the Pleistocene Lissie Formation, which is several hundred thousand years old.

In this discussion, the geologic designations follow the recent geologic maps and reports for the region (*6,10,12,21*). The soil units described in this discussion are those on the general soil map.

Lissie Formation and related eolian features. The oldest surface geologic formation in the county is the Pleistocene Lissie Formation, which underlies the Delfina-Hargill-Willacy unit on the general soil map and the westernmost part of the Lyford-Lozano map unit. The Lissie Formation was probably fluviatile and deltaic in origin and deposited several hundred thousand years ago during a high sea level stage similar to the present. Like the other Pleistocene formations of the Texas Gulf Coast, the Lissie Formation tilted slightly seaward following its deposition (*5*). Its more seaward and coastal margins now underlie the younger Pleistocene and Holocene deposits. Little remains of any fluviatile or deltaic depositional surface features of the Lissie. Instead, the surface consists largely of circular to elliptical rounded hills, or ridges, on which the Hargill soils formed. These hills belong in the general, though somewhat inaccurately named, category of "clay dunes;" that is, eolian landforms underlain by clays, silts, and sands. These features and their adjacent 'blowouts," or wind-erosional basins with their recently accumulated fillings, are the parent materials of the soils of this association. These landforms have been referred to as the "Hargill field of stabilized conical dunes" in which "strong downweathering has made [the hills] oval and haystacklike with fairly steep even sides" (*12*).

Younger clay dunes, also derived from Lissie age sediments, are on the northern, or lee, side of La Sal Vieja, a large wind-excavated lake basin now containing saline or brackish water. These clay dune materials were probably blown out as sand-sized aggregates, or pellets, as the surface of intermittently dry basins yielded cracking and curling clay and silt laminations, which could be broken down and moved by the wind. The several dunelike ridges in the lake probably partly encircle some now drowned subbasins. The Hidalgo soils occupy higher parts of the clay dunes of La Sal Vieja, and the sandier Yturria soils are on the side slopes. In general, these dunes have less circular ground plans and steeper slopes than the Hargill clay dunes, and therefore probably are younger.

The Lissie Formation probably underlies the shallow sandy soils of the Nueces-Sarita and Lyford-Lozano map units to the north. The surface sand of these soils may be unrelated to the Lissie. The large clay dunes on the northwestern sides of both the El Jardin and the Los Becerros blowouts in the easternmost part of the Lyford-Lozano map unit, along the northern edge of the county, are surfaced with Willacy and Lozano soils, respectively. They may represent a yet younger generation of clay dunes blown out of Lissie fluviatile materials.

A recent geologic map of the county (*6*) places the Delfina-Hargill-Willacy map unit within the outcrop area of the Pliocene Goliad Formation. Here, the soils and eolian surficial materials overlie caliche deposits, and the undrained depressions are karstic, or solutional, in origin. Results of detailed drilling within areas of the Goliad containing Rio and Tiocano soils, by the Agricultural Research Service (*1*) in the 1960's, show the complete absence of caliche, and thus probably support the blowout origin of the undrained depressions.

The few caliche deposits exposed in small pits in the Nueces-Sarita map unit to the north probably belong to a surficial type described by Price (*12*) as due to "case-hardening" (hardening during geologic weathering) and induration through the upward capillary movement and evaporation of rainwater solutions penetrating locally very calcareous materials. No soils with petrocalcic horizons or soils otherwise characteristic of the Goliad Formation lithologies occur in this area.

Beaumont and Deweyville Formations. Most of the soils of the county have the Beaumont and possibly the Deweyville Formations of the Pleistocene as their parent materials. The soils include all those of the deltaic plains and uplands, except for the Delfina-Hargill-Willacy unit, and all those of the coastal lowlands, except for the Barrada-Lalinda-Arrada unit. Local drainage and salinity differences and eolian activity have produced variations in parent materials, which were originally similar.

The Beaumont Formation is a younger Pleistocene formation than the Lissie. Like the Lissie, it was deposited during an interglacial stage of high sea level. Radiocarbon dates suggest ages of over 40,000 years and thus times of deposition range from the major Sangamon interglacial stage, between the Illinoian and Wisconsin glacial stages, to a more recent episode of high sea level and ice retreat within the Wisconsin itself.

On topographic maps, the surface of the Beaumont Formation is flat and monotonous as it dips very gently toward the Gulf—a dip that is largely post-depositional. On air photos, particularly those taken during the 1930's before the current intensive cultivation, drainage, and land-leveling activities, the surface displays a complex pattern of meander belts or distributaries and flood basin deposits, only part of which is revealed on the present soil maps (*6*).

The large smooth expanses of the clayey Raymondville-Mercedes unit are soils formed in relict flood basin deposits. The sandier, well drained soils of the Hidalgo-Racombes and the Willacy-Racombes units, of the meander belts or distributaries, formed on point bar and levee deposits and on the finer textured fills of sinuous relict channels and oxbows. Nearer the coast, in areas of the Lyford-Lozano, Willamar-Porfirio, and the Saucel-Latina units, the parent materials are similar but are less well drained and more saline. The relict patterns here make up a complex mass of intertwined and discontinous meander belts. Flood basin deposits seem to be absent. The general trend (*6*) is toward the northeast, where the meander patterns terminate at the Barrada-Lalinda-Arrada unit and the mainland part of the Galveston-Mustang-Dune land unit.

In the northeast-trending patches of the Willacy-Racombes unit around the town of Lyford and of the Hidalgo-Racombes unit cutting through Raymondville, the radii of curvature of the relict meanders are considerably larger than those of most of the Beaumont surface. These large relict meanders continue toward the northeast and include the depression in which Estacas Lake lies, northeast of San Perlita, in the poorly drained Willamar-Porfirio unit. A whole continuum of meander sizes can be seen on the Beaumont surface, including those similar in size to the Holocene resacas and the modern course of the Rio Grande in Cameron County to the south. The contrast between the largest and the smallest meanders is similar to the contrast between the meanders on Holocene flood plains and the Beaumont upland in many counties along the Gulf Coast to the north of Texas. These Deweyville terrace deposits are about 12,000 to 30,000 years old. The juxtaposition and contrast in meander size is unusual and anomalous on a surface presumably of the Beaumont age, as is the excellent degree of preservation of the meander patterns themselves. The surface of the Beaumont from the Sabine River southward to the northern edge of the great South Texas sand sheet in Kleberg and Nueces Counties shows a gradual loss and obliteration of relict fluviatile patterns. This deterioration might be explained by differences in age, but more likely by the southward increase in aridity and increase in eolian activity. The excellent preservation of the meanders in Willacy County is puzzling. Perhaps, the whole surface here is much younger than the Beaumont surface to the north and similar in age to the Deweyville terraces.

A local progressive obscuring of Pleistocene meander patterns can be seen especially well in the area around Estaces Lake, where old channels have been segmented and pockmarked into arcuate chains of blowouts containing such depressional soils as Rio, Tiocano, Lomalta, Incell, Jarron, Latina, and Mercedes soils. The presence of the Mercedes soil may be relevant to the problem of a possible old natural Rio Grande floodway through this area, discussed later in this section. The fading of the meander pattern may be in part related to deposition in this floodway.

Eolian sand sheet and western wind-tidal flat deposits. The deposits of the great South Texas sand sheet include parts of several units on the general soil map. Those of the wind-tidal flat along Laguna Madre on the west include all of the Barrada-Lalinda-Arrada unit and a small part of the Sauz unit around Port Mansfield. The deposits are derived from both Pleistocene and Holocene surface materials. The mapped areas also encompass eolian sediments whose time of deposition spans both Pleistocene and Holocene time.

The southern margin of the sand sheet traverses the northern edge of the county and is pretty well delineated by the southern limits of the Nueces-Sarita, the Falfurrias, and the mainland part of the Galveston-Mustang-Dune land map units. The sand sheet deposits and the Beaumont fluviatile deposits overlap in the northeastern part of the county, as shown by the contrasting northwest grain of the sand sheet, the principal direction of sand transport, and the northeast-trending fluviatile deposits of the Beaumont and Deweyville sediments. The sand sheet deposits and the northwest grain are shown by the northwest-trending inclusions of Sarita and Nueces soils in the Sauz unit and by the many blowouts in the Sauz and Lyford-Lozano units. The fluviatile pattern is shown by the Mercedes-Raymondville and the Willamar-Porfirio units.

The parent materials of many of the soils in the region of the sand sheet range in age from the Lissie, Beaumont, and Deweyville Formations to when sands were blown inland and the sea level was at its lowest (about 18,000 years ago) and through the last rise in sea level when Padre Island was formed. The upper part of the solum of such soils as Nueces, Sarita, Sauz, Yturria, and Delfina soils is, in part, the product of eolian accretions both during and after the major time of soil formation. However, in the Nueces, Sarita, Lyford, and Lozano soils in the northern part of the county, the sediments in the lower part of the solum are of Lissie

age. The Sauz, Falfurrias, Galveston, and Mustang soils in the lower areas are over sediments of Beaumont or younger age, having formed in overlying eolian sands. The parent materials of the very deep sandy soils may have at one time resembled materials of Dune land.

The large-scale areal patterns of dune forms in the Galveston-Mustang-Dune land unit may be unique to the sand sheet and have been called "banner dune complexes" by Price (*12*). These have a V-shaped pattern. The arms of the V diverge downwind from a triangular blowout area to a widening zone of sand, which includes transverse and coppice dunes.

The source of the thick sands of the arenic, grossarenic, and psammentic soils and of soils with a thinner sandy surface layer is a complex question. Some of the sand was undoubtedly blown north and westward from the sandy surface soils or surface deposits of fluviatile origin, such as the meander belt and distributary deposits of the Beaumont Formation (*6*) and the now vanished similar deposits that probably marked the surface of the Lissie Formation. It is somewhat doubtful that these were major sources in view of the loamy and clayey lower part of the solum of the soils now on these deposits. Profile differentiation and the development of sandy A horizons would need to precede such a derivation.

The rather abrupt emergence of the thick, currently active windblown sands of the Galveston-Mustang-Dune land unit on the mainland from the downwind Sauz soil with a thin sandy surface layer suggests that the Sauz soil is the wind-scoured or truncated source of this material. The larger area of Sauz soils just east of this area on the mainland has a sandy surface layer thinner than that to the west. The problem of the origin of the sand blown from the Sauz area still remains.

One obvious source of sand is Padre Island, but Laguna Madre now traps most of the northwestward moving sand from the island. Price (*12*) notes, however, that eolian sand moved across the temporarily dry surface of Laguna Madre in the 1950's.

When sea level was at its lowest, about 260 to 300 feet below its present stage, perhaps 18,000 years ago, barrier precursors of Padre Island and even fluviatile sediments on the then emergent Continental Shelf may have been major sources of sand. These areas may have persisted as sand sources until the present sea level stage and the formation of Padre Island.

Another possible source of sand is a relict feature no longer recognizable in Willacy County, namely, the Pleistocene Ingleside Barrier Island system (*4, 11, 12, 22*). This feature is analogous in origin to the present group of barrier islands along the Texas coast but is found on or in Beaumont and post-Beaumont sediments. In some places it is considerably inland. In others, it is immediately landward of the lagoons inland from the modern barriers. The Ingleside disappears on the northern edge of the sand sheet in Kleberg and Kenedy Counties into a mass of active dunes similar to those of the Galveston-Mustang-Dune land unit. It certainly may have bordered Laguna Madre on the west before the last drop in sea level 18,000 years ago.

Ultimately, the sand of the sand sheet was derived from the early Holocene and Pleistocene precursors of the Rio Grande to the south and of the Guadalupe, Colorado, and Brazos Rivers to the north.

The narrow strip of the Barrada-Lalinda-Arrada map unit along the western margin of Laguna Madre and part of the Sauz unit around Port Mansfield consists of subsiding, wind- and water- modified fluviatile Pleistocene deposits of the Rio Grande and later Holocene deposits of the Arroyo Colorado and an unnamed drainageway southwest of Port Mansfield. Most of this area has been referred to (*7*) as the Hawk Island accretionary clay-sand dune field. The dunes are the higher components of a wind-tidal flat; that is, an area intermittently flooded by wind-driven waters, in this case from Laguna Madre to the east.

Two types of dunes occur in this area. The Lalinda soils formed on these dunes. The first is the "stepped-back eolian ridge" group, described by Price (*12*), which areally presents a gently to very strongly convex arcuate front to Laguna Madre and includes Hawk Island, Mud Island, Josephine Island, Chubby Island, and Green Hill Island. Some dunes in this group may be subsided, wind- and water-modified levees of the Arroyo Colorado. The modified and possibly recurved dunes of the second type, namely those on the western or northwestern sides of blowouts, are similar to the clay dunes of the mainland. In this area they present, in general, a concave arcuate front towards Laguna Madre. The source of the materials in these dunes is the blowouts on the windward sides of the dunes; for the first type, it is the wind-scoured surface of the wind-tidal flats between inundations. The area of Fourmile Slough south of Port Mansfield seems to be an areal mixture of both kinds.

Deer Island in the extreme southeast corner of the county and just west of Padre Island has a similar morphology to the dunes of the first type and may have a similar origin. This area is occupied by the Galveston-Dune land complex and Mustang fine sand rather than Lalinda sandy clay loam, 1 to 5 percent slopes.

The Mercedes soil and a natural northeastern Rio Grande floodway. The large north-south-trending patch of the Raymondville-Mercedes unit in the western part of the county continues into contiguous Hidalgo County and heads south towards a re-entrant of the Holocene Alluvium just west of Mercedes—the entrance area for the manmade floodway that crosses part of southern Willacy County. A study by Price (*12*) and a more recent geologic study (*6*) suggest that this re-entrant was also the place where the "Mercedes-Raymondville" branch of the Rio Grande left the main flood plain. This branch would function as a natural floodway for the Rio Grande.

Price depicts the floodway as passing north of Raymondville, skirting the southern edge of the sand sheet, and entering Laguna Madre north of Port Mansfield. The course of this natural floodway and the deposits associated with it are rather difficult to discern on available geologic, soils, and topographic maps. The Mercedes soils in many places in both Hidalgo and Cameron Counties seem to occupy anomalous topographic positions on Holocene and Pleistocene surfaces. The soil mapping of this survey area suggests the possibility that the northernmost patches of the Raymondville-Mercedes unit as well as the local depressional occurrences of the Mercedes soils might be linked together to constitute this elusive natural floodway. The unnamed channel discharging into Fourmile Slough south of Port Mansfield may be termination of the floodway. The Mercedes soil would then be in part Pleistocene flood basin, and in part, Holocene floodway in origin, thus explaining its somewhat ambiguous topographic and age significance. It also may be completely Holocene in age and occupy Pleistocene surfaces merely as a thin floodway deposit.

Padre Island barrier system. The Padre Island barrier system and the associated wind-tidal flats are represented in this county by the offshore part of the Galveston-Mustang-Dune land unit and the Satatton-Tatton unit. Some of the individual soils overlap several geologic and depositional environments that have been identified in these areas (*6,8,10,12*). The lack of clear-cut relationships between the soils and the depositional environments is related in part to the surface lithologic similarity of the materials deposited and in part to the present net landward retreat and erosion of south Padre Island.

The Beaches, sandy, map unit marks the area of vigorous wave action as sand is moved northward along the shore in response to the net annual northward beach drifting and longshore current movement.

In back of, or landward, of the beach in central and northern Padre Island, is a high vegetated foredune which traps sand blown up from the beach during low tide. In south Padre Island, the foredune is poorly developed or absent because of fires, overgrazing, hurricane erosion, and diminished sand supply from the Rio Grande (*6,10*). The foredune in many places is in the process of rebuilding, as indicated by the coppice dunes of Galveston-Dune land complex, gently undulating, and Satatton-Galveston complex, gently undulating. The areas of Mustang soils and the flatter parts of the Satatton-Galveston complex, among others, seem to be areas of active wind erosion. The sand blown out of the former foredune area is incorporated in the active back island dunes of Dune land. Characteristic of these areas are short, westward-trending, longitudinal dunes that are somewhat oblique to the prevailing southeast wind. The sand here is moving westward across the broad north-south belts of Satatton and Tatton soils into Laguna Madre. When Laguna Madre is dry, some of the sand may be contributed to the clay dunes, and in a minor way, to the sand sheet, on the landward side of the lagoon.

Most of the barrier islands of the Texas Gulf Coast have been traversed by hurricanes, which have cut narrow washover channels. These channels are the narrower parts of the Satatton soils, which terminate against the Beaches, sandy, map unit. These parts are flanked by, among others, Dune land and the Satatton-Galveston complex on the eastern side of Padre Island. After hurricanes, the foredune and beach in central and northern Padre Island are rebuilt and seal off the washover channel from the Gulf; in Willacy County, only the beach recovers. The sediments carried through the washover channel are deposited in washover fans, which bulge towards the mainland. The sediment differences and surface morphology are not sufficient to differentiate the fans from the channels by separate map units, and both fall within the Satatton soil.

The topographically lower parts of the Satatton soil and the Tatton soil are on the wind-tidal flats. The Satatton soil is on the less frequently flooded parts, and the Tatton soil is on the more frequently flooded parts of the flats. The wind-tidal flats are flooded when, for example, northern or northwesterly winter winds drive the waters of Laguna Madre south and southeast.

When sea level stabilized at its present stage over 3,500 years ago, the Rio Grande delta extended gulfward, perhaps 10 miles beyond its present position (*6*). The subsidence due to compaction of clays and erosion due to a diminishing Rio Grande sand supply as a result of more arid conditions contributed to a retreat of the delta. Padre Island began to accumulate as a northward-extending spit from the edge of the delta between 3,400 to 1,900 years ago. This spit eventually coalesced with the central and northern parts of Padre Island.

The sand supply for the barrier is mostly derived from the Rio Grande, and to a minor extent, from shoreward-moving sand from drowned coastal and fluviatile features on the Continental Shelf. With a diminution of sand from the Rio Grande, south Padre Island for the most part is undergoing net erosion and shoreward retreat accompanied by the gradual filling and narrowing of Laguna Madre (*6,10*). Eventually, Padre Island will merge with the mainland, and sand will be directly contributed to the sand sheet.

The decreased sand supply from the Rio Grande may be caused by natural and manmade decreases in discharge from the river and possibly to manmade interference with the northward movement of sand from the river (*6,10*).

References

(1) Allen, R. R., L. R. Ussery, and B. M. Taylor. 1966. Water table depth and ground water salinity in the nonirrigated area of the lower Rio Grande valley of Texas. Agric. Res. Serv. 41-115, 21 pp.

(2) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vols., illus.

(3) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, pt. 19, 464 pp., illus.

(4) Austin, Morris E. 1965. Land resource regions and major land resource areas of the United States. U.S. Dep. Agric. Handb. 296, 82 pp., map.

(5) Bernard, H. A., and R. J. LeBlane, 1965. Resumé of the Quaternary of the Northwestern Gulf of Mexico Province. *In* The Quaternary of the United States. Princeton Univ. Press, pp. 137-185.

(6) Brown, L. F., and others. 1980. Environmental geologic atlas of the Texas coastal zone—Brownsville-Harlingen area. Univ. Tex. Bur. Econ. Geol., 140 pp., illus.

(7) Hunt, C. B. 1974. Natural regions of the United States and Canada. W. H. Freeman and Co., 725 pp.

(8) Hunter, R. E., R. L. Watson, G. W. Hill, and K. A. Dickinson. 1972. Modern depositional environments and processes, northern and central Padre Island, Texas. *In* Gulf Coast Assoc. Geol. Soc., Padre Island National Seashore Field Guide, pp. 1-27.

(9) LeBlano, R. J., and Hodgson, W. D. 1959. Origin and development of the Texas shoreline. Trans Gulf Coast Assoc. Geol. Soc. 9: 197-220.

(10) Morton, R. A., and Pieper, M. J. 1975. Shoreline changes on Brazos Island and south Padre Island. Univ. Tex. Bur. Econ. Geol. Circ. 75-2, 39 pp.

(11) Price, W. A. 1933. Role of diastrophism in topography of Corpus Christi area, South Texas. Amer. Assoc. Petrol. Geol. Bull., vol. 17: 907-926.

(12) Price, W. A. 1958. Sedimentology and Quaternary geomorphology of South Texas: Trans Gulf Coast Assoc. Geol. Soc. 8: 41-75.

(13) Price, W. A. 1963. Physicochemical and environmental factor in clay dune genesis. Jour. Sediment. Petrol.

(14) Texas Agricultural Experiment Station. 1967. Climatic guide—the lower Rio Grande Valley. Bull. MP-841, 108 pp., illus.

(15) Texas Board of Water Engineers. 1961. Groundwater resources of the lower Rio Grande Valley area, Texas. Bull. 6014, vols. 1 and 2.

(16) Texas Historical Commission. 1977. A predictive assessment of cultural resources in Hidalgo and Willacy Counties, Texas. Archeol. Surv. Rep. 23, 308 pp., illus.

(17) United States Department of Agriculture. 1926. Soil survey of Willacy County, Texas. Bur. Chem. and Soils, No. 3, 57 pp., illus.

(18) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]

(19) United States Department of Agriculture. 1954. Diagnosis and improvement of saline and alkali soils. U.S. Dep. Agric. Handb. 60, 160 pp., illus.

(20) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(21) University of Texas Bureau of Economic Geology. 1976. Geologic atlas of Texas: McAllen-Brownsville sheet.

(22) Wilkinson, B. H., J. H. McGowen, and C. R. Lewis. 1975. Ingleside strandplain sand of Central Texas Coast. Amer. Assoc. Petrol. Geol. Bull., vol. 59: 347-352.

Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Chlorosis. A yellowing between veins on upper foliage which results from chlorophyll deficiency. Many factors, including heredity, cause chlorosis.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables) The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Durinodes. Weakly cemented to indurated nodules that do not break down when treated with concentrated HC1 alone. Dry nodules do not slake appreciably in water.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:
O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.
A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.
B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.
C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.
R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Microrelief. Minor surface configurations of the land, such as low mounds and shallow depressions.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium. Soil salinity is commonly expressed in millimhos per centimeter of a saturated extract defined in classes thus:

Nonsaline	0 to 2 millimhos per centimeter
Slightly	2 to 4 millimhos per centimeter
Moderately	4 to 8 millimhos per centimeter
Strongly	8 to 16 millimhos per centimeter
Extremely	more than 16 millimhos per centimeter

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seasonal grazing. The grazing of a range only during a certain period or periods of the year that roughly correspond to one or more of the four seasons.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	Less than 13:1
Moderate	13-30:1
Strong	More than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam. silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-78 at Raymondville, Texas]

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days[1]	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January	69.5	47.0	58.3	89	26	320	1.40	.21	2.29	3	.0
February	73.4	49.4	61.4	91	27	341	1.32	.22	2.15	3	.0
March	79.4	56.5	68.0	97	35	558	.65	.04	1.07	2	.0
April	86.2	64.5	75.3	100	45	759	1.49	.30	2.41	2	.0
May	89.7	69.0	79.4	101	53	911	3.13	.91	4.92	4	.0
June	93.4	72.2	82.8	101	62	984	3.35	1.12	5.19	4	.0
July	95.9	72.8	84.4	103	67	1,066	1.75	.19	2.89	3	.0
August	96.9	72.9	84.9	103	66	1,082	2.93	.45	4.82	5	.0
September	92.3	70.7	81.5	101	58	945	6.11	2.24	9.32	8	.0
October	86.0	62.8	74.4	97	45	756	2.73	.63	4.37	5	.0
November	77.7	55.2	66.5	93	32	495	1.56	.52	2.43	4	.0
December	71.8	49.2	60.5	90	28	344	.98	.14	1.61	3	.0
Yearly:											
Average	84.4	61.9	73.1	---	---	---	---	---	---	---	---
Extreme	---	---	---	105	24	---	---	---	---	---	---
Total	---	---	---	---	---	8,561	27.40	20.60	33.73	46	.0

[1] A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-78 at Raymondville, Texas]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	January 13	February 9	March 2
2 years in 10 later than--	(*)	January 29	February 21
5 years in 10 later than--	(*)	January 2	February 4
First freezing temperature in fall:			
1 year in 10 earlier than--	January 6	December 11	November 20
2 years in 10 earlier than--	(*)	December 21	December 2
5 years in 10 earlier than--	(*)	January 14	December 26

*Probability of occurrence of threshold temperature is less than indicated probability.

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-78 at Raymondville, Texas]

Probability	Daily minimum temperature		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	>365	332	281
8 years in 10	>365	346	294
5 years in 10	>365	>365	324
2 years in 10	>365	>365	>365
1 year in 10	>365	>365	>365

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
An	Arents, loamy	550	0.1
Ar	Arrada sandy clay loam	2,520	0.5
Ba	Barrada clay	9,821	2.1
Bg	Beaches, gravelly	500	0.1
Bs	Beaches, sandy	533	0.1
Ca	Camargo silty clay loam	1,475	0.3
DeA	Delfina loamy fine sand, 0 to 2 percent slopes	2,753	0.6
DfA	Delfina fine sandy loam, 0 to 1 percent slopes	7,280	1.6
DfB	Delfina fine sandy loam, 1 to 3 percent slopes	1,390	0.3
Dn	Dune land	3,923	0.8
FaB	Falfurrias fine sand, gently undulating	6,225	1.3
GaB	Galveston fine sand, gently undulating	5,545	1.2
GdB	Galveston-Dune land complex, gently undulating	1,197	0.3
GmB	Galveston-Mustang complex, gently undulating	5,470	1.2
HaA	Hargill fine sandy loam, 0 to 1 percent slopes	3,005	0.7
HaB	Hargill fine sandy loam, 1 to 3 percent slopes	6,308	1.4
HgB	Hidalgo fine sandy loam, 1 to 3 percent slopes	630	0.1
HoA	Hidalgo sandy clay loam, 0 to 1 percent slopes	27,870	5.9
Ic	Incell clay	4,625	1.0
Ja	Jarron sandy clay loam	6,656	1.4
LaB	Lalinda sandy clay loam, 1 to 5 percent slopes	3,743	0.8
Le	Latina sandy clay loam	5,695	1.2
Lm	Lomalta clay	920	0.2
Ln	Lozano fine sandy loam	21,954	4.7
Ly	Lyford sandy clay loam	25,905	5.5
Me	Mercedes clay	9,490	2.0
Mp	Mercedes clay, ponded	1,595	0.4
Mu	Mustang fine sand	2,830	0.6
Nu	Nueces fine sand	21,700	4.6
Po	Porfirio sandy clay loam	10,890	2.3
Ra	Racombes sandy clay loam	30,639	6.5
Rc	Racombes sandy clay loam, saline	4,840	1.0
Rd	Raymondville clay loam	59,430	12.7
Re	Raymondville clay loam, saline	775	0.2
Rf	Rio fine sandy loam	445	0.1
Rg	Rio sandy clay loam	5,732	1.2
Rs	Rio sandy clay loam, saline	680	0.1
SaB	Sarita fine sand, gently undulating	4,370	0.1
Sf	Satatton fine sand	15,042	3.2
SgB	Satatton-Galveston complex, gently undulating	1,486	0.3
Ss	Saucel sandy loam	7,466	1.6
Su	Sauz fine sand	6,030	1.3
Sz	Sauz loamy fine sand	5,085	1.1
Ta	Tatton fine sand	14,427	3.1
Tc	Tiocano clay	5,044	1.1
UdB	Udipsamments, gently undulating	1,210	0.3
Uf	Ustorthents, loamy	330	0.1
Us	Ustorthents, clayey	1,635	0.4
WaA	Willacy fine sandy loam, 0 to 1 percent slopes	16,690	3.6
WaB	Willacy fine sandy loam, 1 to 3 percent slopes	11,665	2.5
Wf	Willamar fine sandy loam	19,156	4.1
Ws	Willamar fine sandy loam, strongly saline	1,300	0.3
Yf	Yturria fine sandy loam	3,365	0.7
	Water	52,480	11.1
	Total	472,320	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Cotton lint		Grain sorghum		Oranges		Grapefruit		Sugarcane		Pasture	
	N	I	N	I	N	I	N	I	N	I	N	I
	Lb	Lb	Bu	Bu	Box	Box	Box	Box	Ton	Ton	AUM*	AUM*
An. Arents												
Ar---------- Arrada	---	---	---	---	---	---	---	---	---	---	---	---
Ba---------- Barrada	---	---	---	---	---	---	---	---	---	---	---	---
Bg, Bs. Beaches												
Ca---------- Camargo	---	1,100	---	130	---	---	---	---	---	---	---	11
DeA, DfA---------- Delfina	375	900	50	100	---	200	---	300	---	---	4	12
DfB---------- Delfina	250	750	35	80	---	200	---	300	---	---	4	12
Dn. Dune land												
FaB---------- Falfurrias	---	---	---	---	---	---	---	---	---	---	---	---
GaB---------- Galveston	---	---	---	---	---	---	---	---	---	---	---	---
GdB---------- Galveston-Dune land	---	---	---	---	---	---	---	---	---	---	---	---
GmB---------- Galveston-Mustang	---	---	---	---	---	---	---	---	---	---	---	---
HaA---------- Hargill	375	1,100	50	115	---	270	---	375	---	55	4	18
HaB---------- Hargill	250	900	45	90	---	270	---	375	---	55	4	18
HgB---------- Hidalgo	380	950	45	110	---	270	---	375	---	55	6	14
HoA---------- Hidalgo	450	1,200	65	130	---	270	---	375	---	55	7	14
Ic---------- Incell	---	---	---	---	---	---	---	---	---	---	---	---
Ja---------- Jarron	---	---	---	---	---	---	---	---	---	---	10	---
LaB---------- Lalinda	---	---	---	---	---	---	---	---	---	---	5	---
Le---------- Latina	---	---	---	---	---	---	---	---	---	---	---	---
Lm---------- Lomalta	---	---	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Cotton lint		Grain sorghum		Oranges		Grapefruit		Sugarcane		Pasture	
	N	I	N	I	N	I	N	I	N	I	N	I
	Lb	Lb	Bu	Bu	Box	Box	Box	Box	Ton	Ton	AUM*	AUM*
Ln---------- Lozano	375	900	50	100	---	---	---	---	---	---	5	14
Ly---------- Lyford	400	900	50	100	---	---	---	---	---	---	5	14
Me---------- Mercedes	400	1,100	50	126	---	---	---	---	---	---	6	14
Mp---------- Mercedes	---	---	---	---	---	---	---	---	---	---	6	---
Mu---------- Mustang	---	---	---	---	---	---	---	---	---	---	---	---
Nu---------- Nueces	150	400	---	---	---	---	---	---	---	---	3	12
Po---------- Porfirio	350	---	40	---	---	---	---	---	---	---	5	---
Ra---------- Racombes	500	1,000	65	135	---	220	---	325	---	---	6	14
Rc---------- Racombes	150	250	---	35	---	---	---	---	---	---	2	8
Rd---------- Raymondville	425	900	60	105	---	---	---	---	---	45	5	12
Re---------- Raymondville	150	250	---	35	---	---	---	---	---	---	2	8
Rf, Rg---------- Rio	240	725	40	80	---	---	---	---	---	---	4	10
Rs---------- Rio	150	200	---	30	---	---	---	---	---	---	---	8
SaB---------- Sarita	---	---	---	---	---	---	---	---	---	---	3	---
Sf---------- Satatton	---	---	---	---	---	---	---	---	---	---	---	---
SgB---------- Satatton-Galveston	---	---	---	---	---	---	---	---	---	---	---	---
Ss---------- Saucel	---	---	---	---	---	---	---	---	---	---	---	---
Su, Sz---------- Sauz	---	---	---	---	---	---	---	---	---	---	4	---
Ta---------- Tatton	---	---	---	---	---	---	---	---	---	---	---	---
Tc---------- Tiocano	---	---	---	---	---	---	---	---	---	---	4	---
UdB. Udipsamments												
Uf, Us. Ustorthents												
WaA---------- Willacy	500	1,200	70	135	---	310	---	380	---	60	---	---

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Cotton lint		Grain sorghum		Oranges		Grapefruit		Sugarcane		Pasture	
	N	I	N	I	N	I	N	I	N	I	N	I
	Lb	Lb	Bu	Bu	Box	Box	Box	Box	Ton	Ton	AUM*	AUM*
WaB---------- Willacy	425	950	60	105	---	310	---	380	---	60	---	---
Wf---------- Willamar	150	350	20	40	---	---	---	---	---	---	3	4
Ws---------- Willamar	---	---	---	---	---	---	---	---	---	---	---	---
Yf---------- Yturria	350	1,100	45	110	---	225	---	325	---	---	5	13

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 6.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Map symbol and soil name	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
Ca---------- Camargo	Loamy Bottomland----------	7,000	5,000	3,000
DeA---------- Delfina	Loamy Sand----------	4,500	3,800	2,000
DfA, DfB---------- Delfina	Tight Sandy Loam----------	4,000	3,000	2,000
FaB---------- Falfurrias	Sand Hill----------	4,000	3,500	1,500
GaB---------- Galveston	Coastal Sand----------	4,500	3,000	2,000
GdB*: Galveston---------- Dune land.	Coastal Sand----------	3,500	2,500	1,500
GmB*: Galveston----------	Coastal Sand----------	3,500	2,500	2,000
Mustang----------	Low Coastal Sand----------	4,000	3,000	2,000
HaA, HaB---------- Hargill	Sandy Loam----------	5,500	4,000	2,200
HgB, HoA---------- Hidalgo	Gray Sandy Loam----------	4,500	3,500	2,500
Ic---------- Incell	Marsh----------	7,000	5,000	4,000
Ja---------- Jarron	Lakebed----------	5,000	4,000	2,500
LaB---------- Lalinda	Coastal Ridge----------	5,000	3,000	1,000
Le---------- Latina	Salt Flat----------	4,000	2,500	1,000
Lm---------- Lomalta	Salty Marsh----------	4,500	3,000	1,500
Ln---------- Lozano	Tight Sandy Loam----------	5,000	4,200	3,000
Ly---------- Lyford	Clay Loam----------	5,000	4,000	3,000
Me---------- Mercedes	Clay Flat----------	5,000	3,500	2,000
Mp---------- Mercedes	Lakebed----------	5,000	4,000	2,500
Mu---------- Mustang	Low Coastal Sand----------	4,000	3,000	2,000
Nu---------- Nueces	Sandy----------	5,000	4,000	2,000

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
Po---------- Porfirio	Salty Prairie----------	7,000	4,000	2,000
Ra---------- Racombes	Clay Loam----------	6,000	5,000	2,500
Rd---------- Raymondville	Clay Loam----------	5,800	4,500	2,500
Rf, Rg---------- Rio	Lakebed----------	5,000	4,000	2,500
SaB---------- Sarita	Sandy----------	5,000	4,000	2,000
Ss---------- Saucel	Salt Flat----------	3,500	2,500	1,000
Su, Sz---------- Sauz	Sandy Flat----------	5,000	4,000	2,000
Tc---------- Tiocano	Lakebed----------	5,000	4,000	3,000
WaA, WaB---------- Willacy	Sandy Loam----------	5,400	4,500	3,000
Wf---------- Willamar	Sandy Coastal Flat----------	5,500	4,500	2,500
Yf---------- Yturria	Sandy Loam----------	5,000	3,500	2,000

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
An*. Arents					
Ar Arrada	Severe: flooding, ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding, flooding, excess salt.	Severe: ponding.	Severe: excess salt, excess sodium, ponding.
Ba Barrada	Severe: ponding, percs slowly, too clayey.	Severe: ponding, too clayey, excess salt.	Severe: too clayey, ponding, excess salt.	Severe: ponding, too clayey.	Severe: excess salt, ponding, too clayey.
Bg*, Bs*. Beaches					
Ca Camargo	Slight	Slight	Moderate: too clayey.	Slight	Slight.
DeA Delfina	Slight	Slight	Moderate: too sandy.	Slight	Slight.
DfA Delfina	Slight	Slight	Slight	Slight	Slight.
DfB Delfina	Slight	Slight	Moderate: slope.	Slight	Slight.
Dn*. Dune land					
FaB Falfurrias	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
GaB Galveston	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, flooding.
GdB*: Galveston	Severe: flooding, too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty, flooding, slope.
Dune land.					
GmB*: Galveston	Severe: flooding, too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty, flooding.
Mustang	Severe: flooding, wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.	Severe: wetness.
HaA Hargill	Slight	Slight	Slight	Slight	Slight.
HaB Hargill	Slight	Slight	Moderate: slope.	Slight	Slight.
HgB Hidalgo	Slight	Slight	Moderate: slope.	Slight	Slight.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
HoA---- Hidalgo	Slight	Slight	Slight	Slight	Slight.
Ic---- Incell	Severe: ponding.	Severe: ponding.	Severe: too clayey, ponding.	Severe: ponding.	Severe: ponding, too clayey.
Ja---- Jarron	Severe: ponding, excess sodium.	Severe: ponding, excess sodium, excess salt.	Severe: ponding, excess sodium.	Severe: ponding.	Severe: excess sodium, ponding.
LaB---- Lalinda	Moderate: excess salt.	Moderate: excess salt.	Moderate: slope, excess salt.	Slight	Moderate: excess salt.
Le---- Latina	Severe: flooding, wetness, excess salt.	Severe: excess salt.	Severe: wetness, excess salt.	Moderate: wetness.	Severe: excess salt, droughty.
Lm---- Lomalta	Severe: ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding.	Severe: excess salt, ponding, too clayey.
Ln---- Lozano	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Ly---- Lyford	Slight	Slight	Slight	Slight	Slight.
Me---- Mercedes	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
Mp---- Mercedes	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding, too clayey.
Mu---- Mustang	Severe: flooding, wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.	Severe: wetness.
Nu---- Nueces	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
Po---- Porfirio	Severe: flooding.	Moderate: wetness, excess salt.	Moderate: wetness, flooding, excess salt.	Slight	Moderate: excess salt, flooding.
Ra---- Racombes	Severe: flooding.	Slight	Slight	Slight	Slight.
Rc---- Racombes	Severe: flooding, excess salt.	Severe: excess salt.	Severe: excess salt.	Moderate: wetness.	Severe: excess salt, droughty.
Rd---- Raymondville	Slight	Slight	Slight	Slight	Slight.
Re---- Raymondville	Severe: excess salt.	Severe: excess salt.	Severe: excess salt.	Slight	Severe: excess salt.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Rf, Rg Rio	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Rs Rio	Severe: ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding.	Severe: excess salt, ponding.
SaB Sarita	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
Sf Satatton	Severe: flooding, wetness, too sandy.	Severe: too sandy, excess salt.	Severe: too sandy, wetness, flooding.	Severe: too sandy.	Severe: excess salt, flooding, too sandy.
SgB*: Satatton	Severe: flooding, wetness, too sandy.	Severe: too sandy, excess salt.	Severe: too sandy, wetness, flooding.	Severe: too sandy.	Severe: excess salt, flooding, too sandy.
Galveston	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, flooding.
Ss Saucel	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Severe: excess salt, droughty.
Su Sauz	Severe: wetness, too sandy, excess sodium.	Severe: too sandy, excess sodium, excess salt.	Severe: too sandy, wetness, excess sodium.	Severe: too sandy.	Severe: excess sodium.
Sz Sauz	Severe: wetness, excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: wetness, excess sodium, excess salt.	Moderate: wetness, too sandy.	Severe: excess sodium.
Ta Tatton	Severe: ponding, too sandy, excess salt.	Severe: ponding, too sandy, excess salt.	Severe: ponding, excess sodium, excess salt.	Severe: ponding.	Severe: excess salt, excess sodium, ponding.
Tc Tiocano	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding, percs slowly.	Severe: ponding, too clayey.	Severe: ponding, flooding, too clayey.
UdB*. Udipsamments					
Uf*, Us*. Ustorthents					
WaA Willacy	Slight	Slight	Slight	Slight	Slight.
WaB Willacy	Slight	Slight	Moderate: slope.	Slight	Slight.
Wf Willamar	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Slight	Severe: excess salt, excess sodium, droughty.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ws---------- Willamar	Severe: ponding, excess sodium, excess salt.	Severe: ponding, excess sodium, excess salt.	Severe: ponding, excess sodium, excess salt.	Severe: ponding.	Severe: excess salt, excess sodium, ponding.
Yf---------- Yturria	Slight----------	Slight----------	Slight----------	Slight----------	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
An*. Arents									
Ar---------- Arrada	Very poor	Very poor.	Very poor	Very poor.	Very poor.	Fair	Very poor	Poor	Very poor.
Ba---------- Barrada	Very poor	Very poor.	Very poor	Very poor.	Poor	Good	Very poor	Fair	Very poor.
Bg*, Bs*. Beaches									
Ca---------- Camargo	Fair	Fair	Fair	Good	Poor	Very poor.	Fair	Very poor	Fair.
DeA, DfA, DfB------ Delfina	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Dn*. Dune land									
FaB---------- Falfurrias	Very poor	Very poor.	Fair	Good	Very poor.	Very poor.	Poor	Very poor	Fair.
GaB---------- Galveston	Poor	Fair	Fair	Fair	Very poor.	Fair	Fair	Poor	Fair.
GdB*: Galveston---------	Poor	Fair	Fair	Fair	Very poor.	Fair	Fair	Poor	Fair.
Dune land.									
GmB*: Galveston---------	Poor	Fair	Fair	Fair	Very poor.	Fair	Fair	Poor	Fair.
Mustang----------	Poor	Poor	Fair	Fair	Fair	Good	Poor	Fair	Fair.
HaA, HaB---------- Hargill	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor	Good.
HgB, HoA---------- Hidalgo	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor	Good.
Ic---------- Incell	Very poor	Poor	Poor	Very poor.	Good	Good	Poor	Good	Very poor.
Ja---------- Jarron	Poor	Fair	Poor	Fair	Good	Fair	Poor	Fair	Poor.
LaB---------- Lalinda	Fair	Fair	Fair	Good	Poor	Very poor.	Fair	Very poor	Fair.
Le---------- Latina	Poor	Poor	Very poor	Very poor.	Fair	Fair	Poor	Fair	Very poor.
Lm---------- Lomalta	Very poor	Very poor.	Very poor	Very poor.	Poor	Good	Very poor	Fair	Very poor.
Ln---------- Lozano	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor	Good.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Ly---- Lyford	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor	Good.
Me---- Mercedes	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Very poor	Fair.
Mp---- Mercedes	Poor	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair.
Mu---- Mustang	Poor	Poor	Fair	Fair	Fair	Good	Poor	Fair	Fair.
Nu---- Nueces	Fair	Fair	Good	Fair	Poor	Very poor.	Fair	Very poor	Fair.
Po---- Porfirio	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
Ra---- Racombes	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor	Good.
Rc---- Racombes	Poor	Poor	Poor	Poor	Poor	Good	Very poor	Fair	Poor.
Rd---- Raymondville	Good	Good	Fair	Good	Poor	Very poor.	Good	Very poor	Fair.
Re---- Raymondville	Poor	Poor	Poor	Poor	Good	Good	Very poor	Good	Poor.
Rf, Rg---- Rio	Good	Good	Fair	Good	Fair	Fair	Good	Fair	Fair.
Rs---- Rio	Poor	Poor	Poor	Poor	Good	Good	Very poor	Good	Poor.
SaB---- Sarita	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Very poor	Fair.
Sf---- Satatton	Very poor	Very poor.	Very poor	Very poor.	Very poor.	Fair	Very poor	Poor	Very poor.
SgB*:									
Satatton----	Very poor	Very poor.	Very poor	Very poor.	Very poor.	Fair	Very poor	Poor	Very poor.
Galveston----	Poor	Fair	Fair	Fair	Very poor.	Fair	Fair	Poor	Fair.
Ss---- Saucel	Very poor	Very poor.	Very poor	Very poor.	Good	Good	Very poor	Good	Very poor.
Su, Sz---- Sauz	Poor	Poor	Fair	Fair	Fair	Poor	Poor	Poor	Fair.
Ta---- Tatton	Very poor	Very poor.	Very poor	Very poor.	Fair	Fair	Very poor	Fair	Very poor.
Tc---- Tiocano	Very poor	Poor	Poor	Fair	Good	Good	Poor	Good	Poor.
UdB*. Udipsamments									
Uf*, Us*. Ustorthents									

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
WaA, WaB---------- Willacy	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor	Good.
Wf---------- Willamar	Fair	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
Ws---------- Willamar	Poor	Poor	Very poor	Very poor.	Fair	Fair	Very poor	Fair	Very poor.
Yf---------- Yturria	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Very poor	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
An*. Arents						
Ar---------- Arrada	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: excess salt, excess sodium, ponding.
Ba---------- Barrada	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: excess salt, ponding, too clayey.	Severe: excess salt, ponding, too clayey.
Bg*, Bs*. Beaches						
Ca---------- Camargo	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
DeA, DfA, DfB----- Delfina	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Dn*. Dune land						
FaB---------- Falfurrias	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Severe: droughty.
GaB---------- Galveston	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: droughty.
GdB*: Galveston--------	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding, slope.	Moderate: flooding.	Moderate: droughty, slope.
Dune land.						
GmB*: Galveston--------	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: droughty.
Mustang----------	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness.
HaA, HaB---------- Hargill	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Slight.
HgB, HoA---------- Hidalgo	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Ic---------- Incell	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, too clayey.	Severe: ponding, too clayey.
Ja---------- Jarron	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: excess sodium, ponding.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
LaB---- Lalinda	Slight	Slight	Slight	Slight	Moderate: low strength.	Moderate: excess salt.
Le---- Latina	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding.	Severe: excess salt, droughty.
Lm---- Lomalta	Severe: cutbanks cave, ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: excess salt, ponding, too clayey.
Ln---- Lozano	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength.	Moderate: wetness.
Ly---- Lyford	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Slight.
Me---- Mercedes	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
Mp---- Mercedes	Severe: cutbanks cave, ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding, flooding.	Severe: ponding, flooding, too clayey.
Mu---- Mustang	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness.
Nu---- Nueces	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
Po---- Porfirio	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding.	Moderate: excess salt, flooding.
Ra---- Racombes	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: low strength, flooding, shrink-swell.	Slight.
Rc---- Racombes	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: low strength, wetness, flooding.	Severe: excess salt, droughty.
Rd---- Raymondville	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Re---- Raymondville	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: excess salt.
Rf, Rg---- Rio	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
Rs---- Rio	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: excess salt, ponding.
SaB---- Sarita	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Sf---- Satatton	Severe: cutbanks cave, wetness, flooding.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Severe: excess salt, flooding, too sandy.
SgB*: Satatton----	Severe: cutbanks cave, wetness, flooding.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Severe: excess salt, flooding, too sandy.
Galveston----	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: droughty.
Ss---- Saucel	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: excess salt, droughty.
Su, Sz---- Sauz	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, low strength.	Severe: excess sodium.
Ta---- Tatton	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: excess salt, excess sodium, ponding.
Tc---- Tiocano	Severe: cutbanks cave, ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding, flooding.	Severe: ponding, flooding, too clayey.
UdB*. Udipsamments						
Uf*, Us*. Ustorthents						
WaA, WaB--- Willacy	Slight----	Slight----	Slight----	Slight----	Moderate: low strength.	Slight.
Wf---- Willamar	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Severe: excess salt, excess sodium, droughty.
Ws---- Willamar	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: excess salt, excess sodium, ponding.
Yf---- Yturria	Slight----	Slight----	Slight----	Slight----	Slight----	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
An*. Arents					
Ar Arrada	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding, excess salt.	Severe: flooding, ponding.	Severe: ponding, excess salt, excess sodium.
Ba Barrada	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess salt.	Severe: ponding.	Poor: too clayey, ponding, excess salt.
Bg*, Bs*. Beaches					
Ca Camargo	Slight	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
DeA, DfA, DfB Delfina	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Fair: wetness.
Dn*. Dune land					
FaB Falfurrias	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
GaB Galveston	Severe: wetness, poor filter.	Severe: seepage, flooding.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
GdB*: Galveston	Severe: wetness, poor filter.	Severe: seepage, flooding, slope.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Dune land.					
GmB*: Galveston	Severe: wetness, poor filter.	Severe: seepage, flooding.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Mustang	Severe: wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
HaA Hargill	Slight	Moderate: seepage.	Slight	Slight	Good.
HaB Hargill	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
HgB Hidalgo	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
HoA---------- Hidalgo	Moderate: percs slowly.	Moderate: seepage.	Slight----------	Slight----------	Good.
Ic---------- Incell	Severe: ponding, percs slowly.	Slight----------	Severe: ponding.	Severe: ponding.	Poor: ponding.
Ja---------- Jarron	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess sodium.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
LaB---------- Lalinda	Severe: percs slowly.	Moderate: slope.	Severe: excess salt.	Slight----------	Good.
Le---------- Latina	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, excess salt.	Severe: flooding, wetness.	Poor: wetness, excess salt.
Lm---------- Lomalta	Severe: ponding, percs slowly.	Slight----------	Severe: ponding, too clayey, excess salt.	Severe: ponding.	Poor: too clayey, ponding, excess salt.
Ln---------- Lozano	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Ly---------- Lyford	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey.
Me---------- Mercedes	Severe: percs slowly.	Slight----------	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
Mp---------- Mercedes	Severe: ponding, percs slowly, flooding.	Severe: ponding, flooding.	Severe: flooding, ponding, too clayey.	Severe: flooding, ponding.	Poor: too clayey, hard to pack, ponding.
Mu---------- Mustang	Severe: wetness, poor filter, flooding.	Severe: seepage, flooding, wetness.	Severe: seepage, wetness, flooding.	Severe: seepage, wetness, flooding.	Poor: seepage, too sandy, wetness.
Nu---------- Nueces	Severe: percs slowly.	Severe: seepage.	Slight----------	Severe: seepage.	Good.
Po---------- Porfirio	Severe: flooding, wetness, percs slowly.	Slight----------	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, excess salt.
Ra---------- Racombes	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Rc---------- Racombes	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Rd---------- Raymondville	Severe: percs slowly.	Slight----------	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Re Raymondville	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey, excess salt.	Severe: wetness.	Poor: too clayey, hard to pack, excess salt.
Rf, Rg, Rs Rio	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
SaB Sarita	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Sf Satatton	Severe: flooding, wetness, poor filter.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Severe: seepage, flooding, wetness.	Poor: too sandy, wetness, excess salt.
SgB*: Satatton	Severe: flooding, wetness, poor filter.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Severe: seepage, flooding, wetness.	Poor: too sandy, wetness, excess salt.
Galveston	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
Ss Saucel	Severe: flooding, wetness.	Severe: wetness.	Severe: flooding, wetness, excess salt.	Severe: flooding, wetness.	Poor: wetness, excess salt, excess sodium.
Su Sauz	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too sandy, excess salt.	Severe: wetness.	Poor: wetness, excess salt, excess sodium.
Sz Sauz	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, excess sodium, excess salt.	Severe: wetness.	Poor: wetness, excess salt, excess sodium.
Ta Tatton	Severe: ponding.	Severe: seepage, ponding.	Severe: seepage, ponding, excess salt.	Severe: seepage, ponding.	Poor: too sandy, ponding, excess salt.
Tc Tiocano	Severe: flooding, ponding, percs slowly.	Slight	Severe: flooding, ponding, too clayey.	Severe: flooding, ponding.	Poor: too clayey, hard to pack, ponding.
UdB*. Udipsamments					
Uf*, Us*. Ustorthents					
WaA, WaB Willacy	Slight	Moderate: seepage.	Slight	Slight	Good.
Wf Willamar	Severe: wetness, percs slowly.	Slight	Severe: wetness, excess sodium, excess salt.	Severe: wetness.	Poor: excess salt, excess sodium.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ws---------- Willamar	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess sodium, excess salt.	Severe: ponding.	Poor: ponding, excess salt, excess sodium.
Yf---------- Yturria	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
An*. Arents				
Ar Arrada	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness, excess sodium.
Ba Barrada	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt.
Bg*, Bs*. Beaches				
Ca Camargo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
DeA Delfina	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
DfA, DfB Delfina	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Dn*. Dune land				
FaB Falfurrias	Good	Probable	Improbable: too sandy.	Poor: too sandy.
GaB Galveston	Good	Probable	Improbable: too sandy.	Poor: too sandy.
GdB*: Galveston	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Dune land.				
GmB*: Galveston	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Mustang	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
HaA, HaB Hargill	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
HgB Hidalgo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
HoA Hidalgo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
Ic Incell	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Ja Jarron	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness, excess sodium.
LaB Lalinda	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, excess salt.
Le Latina	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
Lm Lomalta	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt.
Ln Lozano	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ly Lyford	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Me Mercedes	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Mp Mercedes	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Mu Mustang	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
Nu Nueces	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
Po Porfirio	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
Ra Racombes	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Rc Racombes	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
Rd Raymondville	Severe: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Re Raymondville	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
Rf, Rg Rio	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, thin layer.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
Rs Rio	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness, thin layer.
SaB Sarita	Good	Improbable: excess fines.	Improbable: too sandy.	Poor: too sandy.
Sf Satatton	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, excess salt, wetness.
SgB*: Satatton	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, excess salt, wetness.
Galveston	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Ss Saucel	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness, excess sodium.
Su, Sz Sauz	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.
Ta Tatton	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness, excess sodium.
Tc Tiocano	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
UdB*. Udipsamments				
Uf*, Us*. Ustorthents				
WaA, WaB Willacy	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Wf Willamar	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.
Ws Willamar	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness, excess sodium.
Yf Yturria	Good	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Map symbol and soil name	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
An*. Arents						
Ar---------- Arrada	Slight---------	Severe: ponding, excess sodium, excess salt.	Severe: salty water.	Ponding, flooding, excess salt.	Ponding, droughty, erodes easily.	Erodes easily, ponding.
Ba---------- Barrada	Slight---------	Severe: ponding, excess salt.	Severe: slow refill, excess salt.	Ponding, percs slowly, excess salt.	Ponding, slow intake, excess salt.	Ponding, percs slowly.
Bg*, Bs*. Beaches						
Ca---------- Camargo	Moderate: seepage.	Moderate: piping.	Severe: no water.	Favorable------	Favorable------	Favorable.
DeA---------- Delfina	Moderate: seepage.	Moderate: wetness.	Severe: deep to water.	Favorable------	Wetness, droughty, fast intake.	Soil blowing.
DfA, DfB---------- Delfina	Moderate: seepage.	Moderate: wetness.	Severe: deep to water.	Favorable------	Wetness--------	Soil blowing.
Dn*. Dune land						
FaB---------- Falfurrias	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake.	Too sandy.
GaB---------- Galveston	Severe: seepage.	Severe: seepage.	Severe: cutbanks cave.	Deep to water	Droughty, fast intake.	Too sandy.
GdB*: Galveston--------	Severe: seepage, slope.	Severe: seepage.	Severe: cutbanks cave.	Deep to water	Droughty, fast intake, slope.	Slope, too sandy.
Dune land.						
GmB*: Galveston--------	Severe: seepage.	Severe: seepage.	Severe: cutbanks cave.	Deep to water	Droughty, fast intake, slope.	Too sandy.
Mustang----------	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, fast intake.	Wetness, too sandy.
HaA, HaB---------- Hargill	Moderate: seepage.	Moderate: piping.	Severe: no water.	Deep to water	Favorable------	Favorable.
HgB, HoA---------- Hidalgo	Severe: seepage.	Moderate: piping.	Severe: no water.	Deep to water	Favorable------	Favorable.
Ic---------- Incell	Slight---------	Severe: piping, ponding.	Slight---------	Ponding, percs slowly.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.
Ja---------- Jarron	Slight---------	Severe: ponding, excess sodium, excess salt.	Severe: slow refill, salty water.	Ponding, percs slowly, excess salt.	Ponding, percs slowly, excess sodium.	Ponding, percs slowly.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
LaB--- Lalinda	Slight	Severe: excess salt, piping.	Severe: no water.	Deep to water	Slope, excess salt.	Favorable.
Le--- Latina	Slight	Severe: wetness, excess salt.	Severe: slow refill, salty water.	Percs slowly, flooding, excess salt.	Wetness, droughty, excess salt.	Wetness, percs slowly.
Lm--- Lomalta	Slight	Severe: hard to pack, ponding, excess salt.	Severe: salty water.	Ponding, percs slowly, excess salt.	Droughty, slow intake, excess salt.	Ponding, percs slowly.
Ln--- Lozano	Moderate: seepage.	Moderate: wetness.	Severe: slow refill.	Favorable	Wetness	Wetness.
Ly--- Lyford	Moderate: seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Favorable	Favorable	Favorable.
Me--- Mercedes	Slight	Severe: hard to pack.	Severe: no water.	Percs slowly	Slow intake, percs slowly.	Percs slowly.
Mp--- Mercedes	Slight	Moderate: hard to pack, ponding.	Severe: no water.	Ponding, percs slowly, flooding.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.
Mu--- Mustang	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, fast intake.	Wetness, too sandy.
Nu--- Nueces	Severe: seepage.	Slight	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.
Po--- Porfirio	Slight	Moderate: excess salt.	Severe: slow refill, salty water.	Percs slowly, flooding, excess salt.	Wetness, percs slowly, flooding.	Wetness, percs slowly.
Ra--- Racombes	Moderate: seepage.	Slight	Severe: no water.	Deep to water	Favorable	Favorable.
Rc--- Racombes	Moderate: seepage.	Severe: wetness, excess salt.	Moderate: slow refill, salty water.	Excess salt	Wetness, droughty, excess salt.	Wetness.
Rd--- Raymondville	Slight	Moderate: hard to pack.	Severe: no water.	Percs slowly	Slow intake, percs slowly.	Percs slowly.
Re--- Raymondville	Slight	Severe: excess salt.	Moderate: slow refill, salty water.	Percs slowly, excess salt.	Wetness, droughty, excess salt.	Wetness, percs slowly.
Rf, Rg--- Rio	Slight	Severe: ponding.	Severe: slow refill.	Ponding, percs slowly.	Ponding, percs slowly.	Ponding, percs slowly.
Rs--- Rio	Slight	Severe: ponding, excess salt.	Severe: slow refill, salty water.	Ponding, percs slowly.	Ponding, droughty, percs slowly.	Ponding, percs slowly.
SaB--- Sarita	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake.	Too sandy.
Sf--- Satatton	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: salty water, cutbanks cave.	Flooding, cutbanks cave, excess salt.	Droughty, fast intake, excess salt.	Wetness, too sandy.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
SgB*:						
Satatton	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: salty water, cutbanks cave.	Flooding, cutbanks cave, excess salt.	Droughty, fast intake, excess salt.	Wetness, too sandy.
Galveston	Severe: seepage.	Severe: seepage.	Severe: cutbanks cave.	Deep to water	Droughty, fast intake.	Too sandy.
Ss Saucel	Severe: seepage.	Severe: wetness, excess sodium, piping.	Severe: salty water.	Excess salt, excess sodium, flooding.	Wetness, excess sodium, excess salt.	Wetness.
Su, Sz Sauz	Moderate: seepage.	Severe: wetness, excess sodium, excess salt.	Severe: salty water.	Excess salt, excess sodium.	Wetness, fast intake, excess salt.	Wetness, too sandy.
Ta Tatton	Severe: seepage.	Severe: piping, ponding, excess salt.	Severe: salty water, cutbanks cave.	Ponding, excess salt, cutbanks cave.	Ponding, droughty, excess salt.	Ponding, too sandy.
Tc Tiocano	Slight	Severe: hard to pack, ponding.	Severe: no water.	Ponding, percs slowly, flooding.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.
UdB*. Udipsamments						
Uf*, Us*. Ustorthents						
WaA, WaB Willacy	Moderate: seepage.	Slight	Severe: no water.	Favorable	Favorable	Favorable.
Wf Willamar	Slight	Severe: excess salt, excess sodium.	Severe: salty water, slow refill.	Percs slowly, excess salt, excess sodium.	Percs slowly, excess sodium, excess salt.	Percs slowly.
Ws Willamar	Slight	Severe: ponding, excess sodium, excess salt.	Severe: slow refill, salty water.	Ponding, percs slowly, excess salt.	Ponding, percs slowly, excess sodium.	Ponding, percs slowly.
Yf Yturria	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Favorable	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than. Absence of an entry indicates that data were not estimated]

Map symbol and soil name	Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	4	10	40	200		
	In								Pct	
An*. Arents										
Ar---------- Arrada	0-16	Sandy clay loam	SC, SM-SC	A-2-4, A-2-6, A-4, A-6	95-100	95-100	65-96	20-35	21-34	5-14
	16-54	Sandy clay loam, fine sandy loam, clay loam.	SC	A-4, A-6	95-100	95-100	70-98	25-50	28-43	9-21
	54-80	Stratified clay to loamy fine sand.	SC, CL, SM-SC, CL-ML	A-2-4, A-2-6, A-4, A-6	95-100	95-100	50-100	15-55	21-40	5-20
Ba---------- Barrada	0-40	Clay----------	CH	A-7-6	90-100	85-100	80-100	80-100	51-66	27-39
	40-60	Silty clay loam, clay, sandy clay loam.	CH, CL	A-7-6, A-6	90-100	85-100	80-100	70-100	30-52	11-28
Bg*, Bs*. Beaches										
Ca---------- Camargo	0-9	Silty clay loam	CL, CL-ML	A-6, A-4	100	100	95-100	70-100	20-35	4-16
	9-65	Stratified very fine sandy loam to clay.	CL	A-6, A-7-6	100	100	95-100	70-100	30-45	11-25
DeA---------- Delfina	0-17	Loamy fine sand	SM, SM-SC	A-2-4, A-4	100	100	85-100	20-45	<25	NP-7
	17-32	Sandy clay loam, clay loam.	SC, CL	A-6, A-7-6	100	95-100	90-100	38-55	31-48	18-35
	32-80	Sandy clay loam, fine sandy loam.	SC	A-6, A-7-6	90-100	75-100	70-100	36-50	30-46	16-31
DfA, DfB--------- Delfina	0-15	Fine sandy loam	SM-SC, SC, SM	A-2-4, A-4	100	100	90-100	25-50	19-30	3-10
	15-33	Sandy clay loam, clay loam.	SC, CL	A-6, A-7-6	100	95-100	90-100	38-55	31-48	18-35
	33-80	Sandy clay loam, fine sandy loam.	SC	A-6, A-7-6	90-100	75-100	70-100	36-50	30-46	16-31
Dn*. Dune land										
FaB---------- Falfurrias	0-80	Fine sand--------	SP-SM, SM	A-2-4, A-3	100	100	75-100	5-25	<25	NP-3
GaB---------- Galveston	0-6	Fine sand--------	SP-SM, SM, SP	A-3, A-2-4	100	95-100	65-90	2-20	<30	NP-3
	6-65	Fine sand, sand	SW-SM, SP-SM, SP	A-3	100	90-100	65-90	2-10	<30	NP-3
GdB*: Galveston-------	0-6	Fine sand--------	SP-SM, SM, SP	A-3, A-2-4	100	95-100	65-90	2-20	<30	NP-3
	6-65	Fine sand, sand	SW-SM, SP-SM, SP	A-3	100	90-100	65-90	2-10	<30	NP-3
Dune land.										

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	4	10	40	200		
	In								Pct	
GmB*:										
Galveston	0-8	Fine sand	SP-SM, SM, SP	A-3, A-2-4	100	95-100	65-90	2-20	<30	NP-3
	8-60	Fine sand, sand	SW-SM, SP-SM, SP	A-3	100	90-100	65-90	2-10	<30	NP-3
Mustang	0-8	Fine sand	SW-SM, SP-SM, SP	A-2-4, A-3	85-100	80-100	60-80	2-12	<25	NP-3
	8-60	Fine sand, sand	SW-SM, SP-SM, SP	A-2-4, A-3	85-100	80-100	60-80	2-12	<25	NP-3
HaA, HaB	0-14	Fine sandy loam	SC, SM-SC, SM	A-2-4	100	95-100	95-100	17-35	<30	NP-8
Hargill	14-42	Sandy clay loam	SC, CL	A-6	100	95-100	95-100	40-55	30-40	11-20
	42-65	Sandy clay loam	SC	A-2-4, A-2-6, A-4, A-6	85-100	80-100	75-100	34-50	28-39	9-18
HgB	0-18	Fine sandy loam	SC, SM-SC	A-4, A-6	100	95-100	90-100	36-50	20-30	4-11
Hidalgo	18-36	Sandy clay loam, clay loam.	SC, CL	A-6	100	95-100	90-100	36-80	30-40	11-20
	36-60	Clay loam, sandy clay loam.	CL, SC	A-6, A-7-6	90-100	80-100	75-99	44-80	30-44	11-23
HoA	0-14	Sandy clay loam	SC, CL	A-6	100	95-100	90-100	36-55	29-40	11-20
Hidalgo	14-42	Sandy clay loam, clay loam.	SC, CL	A-6	100	95-100	90-100	36-80	30-40	11-20
	42-60	Clay loam, sandy clay loam.	CL, SC	A-6, A-7-6	90-100	80-100	75-99	44-80	30-44	11-23
Ic	0-25	Clay	CL, CH	A-6, A-7-6	100	95-100	90-100	70-95	33-56	18-38
Incell	25-60	Sandy clay loam, clay loam, loam.	SC, CL, CL-ML, SM-SC	A-4, A-6, A-7-6	95-100	90-100	85-97	36-60	25-43	5-22
Ja	0-7	Sandy clay loam	CL, SC	A-4, A-6	100	95-100	90-100	45-80	20-36	8-20
Jarron	7-36	Sandy clay, clay, clay loam.	CL, CH	A-6, A-7-6	100	95-100	90-100	75-95	33-53	20-38
	36-65	Clay loam, clay, sandy clay loam.	SC, CL, CH	A-6, A-7-6	100	90-100	85-95	45-90	25-53	15-38
LaB	0-6	Sandy clay loam	CL, SC, CL-ML, SM	A-4	100	100	95-100	36-70	<25	NP-10
Lalinda	6-30	Sandy clay loam, clay loam.	CL, CL-ML, ML	A-4, A-6	100	95-100	95-100	51-70	<32	NP-21
	30-56	Sandy clay loam, clay loam.	CL, CL-ML, ML	A-4, A-6	100	95-100	95-100	51-70	<32	NP-21
	56-72	Clay loam, sandy clay loam, fine sandy loam.	CL, SC, SM-SC, CL-ML	A-4, A-6	100	95-100	90-100	40-70	<40	NP-25
Le	0-4	Sandy clay loam	CL	A-4, A-6	100	100	90-100	51-70	23-39	7-18
Latina	4-60	Sandy clay loam, clay loam.	CL	A-6, A-7-6	95-100	90-100	90-100	51-70	34-44	14-22
Lm	0-44	Clay	CH	A-7-6	100	100	100	95-100	68-85	45-60
Lomalta	44-65	Stratified silty clay loam to silt loam.	CL, CH	A-6, A-7-6	100	100	95-100	51-95	26-56	11-33
Ln	0-16	Fine sandy loam	SM-SC, SC, SM	A-4	100	100	95-100	36-50	<30	NP-10
Lozano	16-34	Sandy clay loam, clay loam.	CL	A-6, A-7-6	100	100	95-100	51-70	34-43	14-22
	34-65	Sandy clay loam, clay loam.	CL	A-6, A-7-6	95-100	90-100	90-100	51-70	34-43	14-22

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	4	10	40	200		
	In								Pct	
Ly	0-12	Sandy clay loam	CL	A-6	100	100	95-100	51-70	30-40	11-20
Lyford	12-40	Sandy clay loam, clay loam.	CL	A-6, A-7-6	100	100	95-100	51-70	34-43	15-22
	40-60	Sandy clay loam, clay loam.	CL	A-6, A-7-6	95-100	90-100	85-100	51-70	34-43	15-22
Me, Mp	0-12	Clay	CH	A-7-6	85-100	80-100	80-100	75-95	55-76	32-49
Mercedes	12-48	Clay	CH	A-7-6	85-100	80-100	80-100	75-95	50-76	32-49
	48-80	Clay	CH	A-7-6	85-100	80-100	80-100	75-95	48-76	32-49
Mu	0-8	Fine sand	SW-SM, SP-SM, SP	A-2-4, A-3	85-100	80-100	60-80	2-12	<25	NP-3
Mustang	8-60	Fine sand, sand	SW-SM, SP-SM, SP	A-2-4, A-3	85-100	80-100	60-80	2-12	<25	NP-3
Nu	0-22	Fine sand	SP-SM, SM, SM-SC	A-2-4, A-3	100	95-100	90-100	8-35	<25	NP-6
Nueces	22-76	Sandy clay loam, sandy loam.	SC	A-2-6, A-2-4	90-100	90-100	80-100	20-35	25-40	8-20
Po	0-12	Sandy clay loam	CL	A-6, A-7-6	100	100	90-100	51-85	32-48	15-26
Porfirio	12-36	Clay loam, clay, sandy clay.	CL, CH	A-6, A-7-6	95-100	90-100	90-100	65-95	36-53	21-30
	36-65	Clay loam, sandy clay loam, clay.	CL, CH	A-6, A-7-6	95-100	90-100	90-100	65-95	34-53	15-30
Ra	0-10	Sandy clay loam	CL, SC	A-4, A-6	100	100	95-100	45-65	27-35	8-15
Racombes	10-44	Sandy clay loam, clay loam.	CL, SC	A-6, A-7	100	95-100	90-100	45-65	34-43	15-22
	44-60	Sandy clay loam, clay loam.	CL, SC	A-6	90-100	80-100	80-95	40-65	30-40	11-20
Rc	0-10	Sandy clay loam	CL, SC	A-4, A-6	100	100	95-100	45-65	27-35	8-15
Racombes	10-34	Sandy clay loam, clay loam.	CL, SC	A-6, A-7-6	100	95-100	90-100	45-65	34-43	15-22
	34-60	Sandy clay loam, clay loam.	CL, SC	A-6	90-100	80-100	80-95	40-65	30-40	11-20
Rd, Re	0-16	Clay loam	CL	A-6, A-7-6	100	100	95-100	51-85	37-50	18-30
Raymondville	16-46	Clay, clay loam	CL, CH	A-6, A-7-6	100	95-100	95-100	75-95	38-55	19-35
	46-60	Clay, clay loam	CL, CH	A-7-6	100	85-100	80-100	75-95	40-53	20-30
Rf	0-18	Fine sandy loam	SC, SM-SC	A-2-4, A-4	95-100	95-100	95-100	30-48	<30	5-10
Rio	18-44	Clay loam, clay	CL, CH	A-7-6	95-100	95-100	95-100	75-95	43-57	21-32
	44-60	Clay loam, sandy clay, sandy clay loam.	CL	A-7-6	95-100	95-100	85-95	55-80	41-50	20-27
Rg	0-10	Sandy clay loam	CL	A-6, A-7	95-100	95-100	95-100	70-80	35-45	15-22
Rio	10-44	Clay loam, clay	CL, CH	A-7-6	95-100	95-100	95-100	75-95	43-57	21-32
	44-65	Clay loam, sandy clay, sandy clay loam.	CL	A-7-6	95-100	95-100	85-95	55-80	41-50	20-27
Rs	0-16	Sandy clay loam	CL	A-6, A-7-6	95-100	95-100	95-100	70-80	35-45	15-22
Rio	16-36	Clay loam, clay	CL, CH	A-7-6	95-100	95-100	95-100	75-95	43-57	21-32
	36-60	Clay loam, sandy clay, sandy clay loam.	CL	A-7-6	95-100	95-100	85-95	55-80	41-50	20-27
SaB	0-50	Fine sand	SM-SC, SP-SM, SM	A-2-4, A-3	100	100	65-100	9-35	<25	NP-7
Sarita	50-80	Sandy clay loam, fine sandy loam.	SC	A-2-6, A-6	100	100	80-100	30-50	28-40	11-22

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	4	10	40	200		
	In								Pct	
Sf---------- Satatton	0-60	Fine sand---------	SM	A-2-4, A-4	85-100	80-100	80-98	13-40	<25	NP-3
SgB*: Satatton---------	0-60	Fine sand---------	SM	A-2-4, A-4	85-100	80-100	80-98	13-40	<25	NP-3
Galveston-------	0-12	Fine sand---------	SP-SM, SM, SP	A-3, A-2-4	100	95-100	65-90	2-20	<30	NP-3
	12-80	Fine sand, sand	SW-SM, SP-SM, SP	A-3	100	90-100	65-90	2-10	<30	NP-3
Ss---------- Saucel	0-4	Sandy loam--------	SM, SM-SC, SC	A-2-4, A-4	100	90-100	90-100	15-45	<30	NP-10
	4-44	Sandy loam--------	SM, SM-SC	A-2-4	100	90-100	90-100	15-25	<25	NP-7
	44-62	Sandy clay loam, loamy sand, sandy loam.	SM-SC, SC	A-2-4, A-2-6, A-4, A-6	100	90-100	90-100	15-50	17-40	4-20
Su---------- Sauz	0-12	Fine sand---------	SM, SM-SC, SP-SM	A-2-4, A-3	100	95-100	90-100	8-35	<25	NP-6
	12-50	Sandy clay loam, fine sandy loam, sandy loam.	SC, SM-SC, SM	A-2-4, A-2-6	90-100	85-100	50-99	25-60	20-35	3-16
	50-65	Fine sandy loam, sandy clay loam, sandy loam.	SC, SM-SC, SM	A-2-4, A-2-6	90-100	85-100	50-95	25-49	20-35	3-16
Sz---------- Sauz	0-7	Loamy fine sand	SM, SM-SC, SP-SM	A-2-4, A-3	100	95-100	90-100	8-35	<25	NP-6
	7-40	Sandy clay loam, fine sandy loam, sandy loam.	SC, SM-SC, SM	A-2-4, A-2-6	90-100	85-100	50-99	20-35	20-35	3-16
	40-65	Fine sandy loam, sandy clay loam, sandy loam.	SC, SM-SC, SM	A-2-4, A-2-6	90-100	85-100	50-100	20-35	20-35	3-16
Ta---------- Tatton	0-5	Fine sand---------	SM	A-2-4, A-4	85-100	80-100	80-98	20-50	<25	NP-3
	5-60	Loamy fine sand, loamy sand.	SM	A-2-4, A-4	85-100	80-100	80-98	13-40	<25	NP-3
Tc---------- Tiocano	0-70	Clay----------	CH	A-7-6	100	100	95-100	85-100	56-76	33-49
UdB*. Udipsamments										
Uf*, Us*. Ustorthents										
WaA, WaB--------- Willacy	0-14	Fine sandy loam	SC, SM-SC	A-2-4, A-4	100	100	95-100	30-45	20-30	5-10
	14-65	Sandy clay loam, fine sandy loam.	SC, CL	A-4, A-6	95-100	90-100	90-100	36-65	28-40	9-20
Wf---------- Willamar	0-6	Fine sandy loam	SC, SM-SC	A-4, A-6	100	100	95-100	20-35	20-35	4-17
	6-28	Clay loam, sandy clay loam.	CL, SC	A-6	95-100	90-100	90-100	35-55	28-40	15-25
	28-65	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	90-100	85-100	85-100	35-70	26-38	15-30
Ws---------- Willamar	0-6	Fine sandy loam	SC, SM-SC	A-4, A-6	100	100	95-100	36-70	20-35	4-15
	6-36	Clay loam, sandy clay loam, sandy clay.	CL	A-6	95-100	90-100	90-100	51-70	32-40	15-21
	36-65	Sandy clay loam, clay loam.	CL	A-4, A-6	90-100	85-100	85-100	51-70	26-38	15-30

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	4	10	40	200		
	In								Pct	
Yf---------- Yturria	0-8	Fine sandy loam	SM, SM-SC, SC, SP-SM	A-2-4, A-3	100	95-100	90-100	8-35	<25	NP-10
	8-65	Fine sandy loam, loam.	SM, SM-SC, SC, SP-SM	A-2-4, A-2-6, A-4, A-6	100	93-100	85-100	10-40	<30	NP-13

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Map symbol and soil name	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
								K	T	
	In	Pct	In/hr	In/in	pH	Mmhos/cm				Pct
An*. Arents										
Ar	0-5	10-30	0.2-0.6	0.-0.01	7.9-9.0	>16	Low	0.43	5	<1
Arrada	5-54	18-35	0.2-0.6	0.-0.01	7.9-9.0	>16	Low	0.43		
	54-80	8-35	0.2-0.6	0.-0.01	7.9-9.0	>16	Low	0.43		
Ba	0-40	45-60	<0.06	0.-0.01	>8.4	>16	High	0.32	5	<1
Barrada	40-60	30-55	<0.06	0.-0.01	>8.4	>16	Moderate	0.32		
Bg*, Bs*. Beaches										
Ca	0-9	10-35	0.6-2.0	0.16-0.24	7.9-8.4	<2	Moderate	0.43	5	.5-1
Camargo	9-65	18-35	0.6-2.0	0.15-0.24	7.9-8.4	<4	Moderate	0.43		
DeA	0-17	4-12	2.0-6.0	0.07-0.11	6.6-7.8	<2	Low	0.24	5	<1
Delfina	17-32	25-35	0.2-0.6	0.10-0.20	6.6-8.4	<4	Moderate	0.32		
	32-80	23-35	0.6-2.0	0.10-0.17	7.4-8.4	<4	Moderate	0.32		
DfA, DfB	0-15	7-20	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.24	5	<1
Delfina	15-33	25-35	0.2-0.6	0.10-0.20	6.6-8.4	<4	Moderate	0.32		
	33-80	23-35	0.6-2.0	0.10-0.17	7.4-8.4	<4	Moderate	0.32		
Dn*. Dune land										
FaB	0-80	1-9	6.0-20	0.02-0.08	6.1-8.4	<2	Very low	0.15	5	.5-1
Falfurrias										
GaB	0-6	2-8	6.0-20	0.05-0.10	5.6-8.4	<4	Low	0.15	5	<.5
Galveston	6-65	2-8	6.0-20	0.05-0.10	5.6-8.4	<4	Low	0.15		
GdB*:										
Galveston	0-6	2-8	6.0-20	0.05-0.10	5.6-8.4	<4	Low	0.15	5	<.5
	6-65	2-8	6.0-20	0.05-0.10	5.6-8.4	<4	Low	0.15		
Dune land.										
GmB*:										
Galveston	0-6	2-8	6.0-20	0.05-0.10	5.6-8.4	<4	Low	0.15	5	<.5
	6-65	2-8	6.0-20	0.05-0.10	5.6-8.4	<4	Low	0.15		
Mustang	0-8	2-8	6.0-20	0.01-0.07	6.6-8.4	<4	Low	0.15	5	<1
	8-60	2-8	6.0-20	0.01-0.06	6.6-8.4	<8	Low	0.15		
HaA, HaB	0-14	10-16	0.6-2.0	0.10-0.15	6.6-7.8	<2	Low	0.24	5	1-3
Hargill	14-42	21-33	0.6-2.0	0.12-0.17	6.6-8.4	<2	Moderate	0.32		
	42-65	20-33	0.6-2.0	0.12-0.17	7.9-8.4	<2	Low	0.32		
HgB	0-14	15-20	0.6-2.0	0.08-0.15	7.9-8.4	<4	Low	0.24	5	1-3
Hidalgo	14-42	23-31	0.6-2.0	0.08-0.17	7.9-8.4	<4	Moderate	0.32		
	42-60	23-35	0.6-2.0	0.08-0.20	7.9-9.0	<4	Moderate	0.32		
HoA	0-14	20-30	0.6-2.0	0.08-0.17	7.9-8.4	<4	Moderate	0.32	5	1-3
Hidalgo	14-42	23-31	0.6-2.0	0.08-0.17	7.9-8.4	<4	Moderate	0.32		
	42-60	23-35	0.6-2.0	0.08-0.20	7.9-9.0	<4	Moderate	0.32		
Ic	0-25	35-50	<0.06	0.15-0.20	6.1-7.3	<4	High	0.32	5	1-3
Incell	25-60	18-35	<0.06	0.15-0.20	7.4-8.4	<4	Moderate	0.28		

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
								K	T	
	In	Pct	In/hr	In/in	pH	Mmhos/cm				Pct
Ja	0-8	15-30	0.6-2.0	0.09-0.19	6.1-7.3	2-8	Low	0.28	5	1-3
Jarron	8-36	35-50	0.06-0.2	0.03-0.17	6.1-9.0	4-16	High	0.28		
	36-65	25-50	0.06-0.2	0.01-0.12	7.9-9.0	>8	High	0.28		
LaB	0-6	15-30	0.6-2.0	0.10-0.20	7.4-8.4	2-8	Low	0.32	5	1-3
Lalinda	6-30	18-35	0.2-0.6	0.11-0.19	7.9-9.0	4-8	Low	0.32		
	30-56	18-35	0.2-0.6	0.01-0.11	7.9-9.0	8-16	Low	0.32		
	56-72	15-40	0.2-0.6	0.-0.05	7.9-9.0	>16	Moderate	0.32		
Le	0-4	14-30	0.6-2.0	0.01-0.05	7.9-8.4	>16	Low	0.32	5	---
Latina	4-60	25-35	0.06-0.2	0.01-0.04	7.9-9.0	>16	Moderate	0.32		
Lm	0-44	60-75	<0.06	0.01-0.08	7.9-9.0	>8	Very high	0.32	5	---
Lomalta	44-65	20-40	0.2-2.0	0.01-0.03	7.9-9.0	>16	Moderate	0.32		
Ln	0-16	8-20	0.6-6.0	0.10-0.15	6.6-7.8	<4	Low	0.24	5	<1
Lozano	16-34	25-35	0.2-0.6	0.11-0.19	6.6-8.4	<4	Moderate	0.32		
	34-65	---	0.6-2.0	0.10-0.17	7.9-8.4	<4	Moderate	0.32		
Ly	0-12	20-28	0.6-2.0	0.15-0.20	6.6-7.8	<4	Moderate	0.24	5	<2
Lyford	12-40	25-35	0.6-2.0	0.13-0.19	6.6-7.8	<4	Moderate	0.24		
	40-60	24-35	0.6-2.0	0.12-0.18	7.4-8.4	<4	Moderate	0.28		
Me, Mp	0-12	---	<0.06	0.12-0.18	7.9-8.4	<4	Very high	0.32	5	---
Mercedes	12-48	---	<0.06	0.09-0.15	7.9-9.0	<8	Very high	0.32		
	48-80	---	<0.06	0.06-0.20	7.9-9.0	>4	Very high	0.32		
Mu	0-8	2-8	6.0-20	0.01-0.07	6.6-8.4	<4	Low	0.15	5	<1
Mustang	8-60	2-8	6.0-20	0.01-0.06	6.6-8.4	<8	Low	0.15		
Nu	0-22	2-12	2.0-6.0	0.05-0.10	5.6-7.3	<2	Low	0.17	5	<1
Nueces	22-76	18-30	0.2-0.6	0.12-0.17	6.6-8.4	<2	Moderate	0.24		
Po	0-12	25-40	0.2-0.6	0.12-0.18	7.9-9.0	4-8	Moderate	0.28	5	1-3
Porfirio	12-36	35-45	0.06-0.2	0.10-0.16	7.9-9.0	>4	Moderate	0.28		
	36-65	25-45	0.06-0.2	0.-0.05	7.9-9.0	>8	Moderate	0.28		
Ra	0-10	16-28	0.6-2.0	0.14-0.19	6.6-7.8	<2	Low	0.28	5	1-3
Racombes	10-44	26-34	0.6-2.0	0.15-0.20	6.6-8.4	<4	Moderate	0.32		
	44-60	25-34	0.6-2.0	0.15-0.20	7.9-8.4	<4	Low	0.32		
Rc	0-10	16-28	0.6-2.0	0.04-0.12	6.6-7.8	4-16	Low	0.28	5	1-3
Racombes	10-34	25-34	0.6-2.0	0.04-0.13	6.6-8.4	4-16	Moderate	0.32		
	34-60	22-34	0.6-2.0	0.04-0.13	7.9-8.4	>4	Moderate	0.32		
Rd	0-16	32-42	0.2-0.6	0.12-0.18	7.9-8.4	<4	High	0.32	5	1-3
Raymondville	16-46	35-50	0.06-0.2	0.10-0.18	7.9-8.4	<4	High	0.32		
	46-60	35-45	0.06-0.2	0.10-0.18	7.9-8.4	<4	High	0.32		
Re	0-16	32-42	0.2-0.6	0.04-0.11	7.9-8.4	4-16	High	0.28	5	1-3
Raymondville	16-46	35-50	0.06-0.2	0.04-0.11	7.9-8.4	4-16	High	0.28		
	46-60	35-45	0.06-0.2	0.04-0.11	7.9-8.4	>4	High	0.32		
Rf	0-18	12-20	0.6-2.0	0.15-0.20	6.6-7.8	<4	Low	0.32	5	1-3
Rio	18-44	35-50	0.06-0.2	0.13-0.18	7.4-8.4	<4	Moderate	0.32		
	44-60	30-40	0.2-0.6	0.12-0.17	7.9-8.4	<4	Moderate	0.32		
Rg	0-10	20-35	2.0-6.0	0.14-0.18	6.6-7.8	<4	Moderate	0.24	5	1-3
Rio	10-44	35-50	0.06-0.2	0.13-0.18	7.4-8.4	<4	Moderate	0.32		
	44-65	30-40	0.2-0.6	0.12-0.17	7.9-8.4	<4	Moderate	0.32		
Rs	0-16	20-35	0.6-2.0	0.04-0.12	6.6-7.8	4-16	Moderate	0.32	5	1-3
Rio	16-60	35-50	0.06-0.2	0.04-0.11	7.4-8.4	4-16	Moderate	0.32		
	60-72	30-40	0.2-0.6	0.04-0.10	7.9-8.4	>4	Moderate	0.32		
SaB	0-50	1-13	6.0-20	0.05-0.10	6.1-7.3	<2	Low	0.17	5	<1
Sarita	50-80	18-34	2.0-6.0	0.13-0.19	5.6-8.4	<2	Moderate	0.24		

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
								K	T	
	In	Pct	In/hr	In/in	pH	Mmhos/cm				Pct
Sf---------- Satatton	0-60	1-10	6.0-20	0	8.5-9.0	>16	Low----------	0.15	5	<1
SgB*:										
Satatton--------	0-60	1-10	6.0-20	0	8.5-9.0	>16	Low----------	0.15	5	<1
Galveston-------	0-12	2-8	6.0-20	0.05-0.10	5.6-8.4	<4	Low----------	0.15	5	<.5
	12-80	2-8	6.0-20	0.05-0.10	5.6-8.4	<4	Low----------	0.15		
Ss----------	0-4	4-17	0.6-2.0	0.-0.05	7.9-9.0	>16	Low----------	0.17	5	.5-1
Saucel	4-44	10-17	0.6-2.0	0.-0.05	7.9-9.0	>16	Low----------	0.17		
	44-62	4-28	0.2-2.0	0.-0.05	7.9-9.0	>16	Moderate------	0.17		
Su, Sz----------	0-12	2-12	2.0-6.0	0.05-0.10	6.6-7.8	2-4	Low----------	0.20	5	<1
Sauz	12-50	10-18	0.2-0.6	0.08-0.13	7.9-9.0	2-16	Low----------	0.32		
	50-65	10-25	0.6-2.0	0.02-0.10	7.9-9.0	>8	Low----------	0.32		
Ta----------	0-5	2-12	6.0-20	0.-0.02	7.9-9.0	>16	Very low------	0.17	2	<1
Tatton	5-60	2-12	6.0-20	0.-0.02	7.9-9.0	>16	Very low------	0.15		
Tc---------- Tiocano	0-70	40-60	<0.06	0.12-0.18	6.6-8.4	<4	Very high-----	0.32	5	1-3
UdB*. Udipsamments										
Uf*, Us*. Ustorthents										
WaA, WaB----------	0-14	12-22	2.0-6.0	0.14-0.18	7.4-7.8	<4	Low----------	0.24	5	1-3
Willacy	14-65	18-33	0.6-2.0	0.14-0.18	7.4-8.4	<4	Low----------	0.32		
Wf----------	0-6	15-25	0.2-0.6	0.08-0.17	6.6-8.4	2-16	Low----------	0.32	4	<1
Willamar	6-28	25-35	<0.06	0.01-0.09	7.9-9.0	8-16	Moderate------	0.32		
	28-65	25-35	0.06-0.2	0.01-0.05	7.9-9.0	>16	Moderate------	0.32		
Ws----------	0-6	15-25	0.2-0.6	0.-0.04	6.6-8.4	>16	Low----------	0.32	4	<1
Willamar	6-36	25-35	<0.06	0.-0.03	7.9-9.0	>16	Moderate------	0.32		
	36-65	25-35	0.06-0.2	0.-0.02	7.9-9.0	>16	Moderate------	0.32		
Yf----------	0-8	5-17	2.0-6.0	0.09-0.15	6.6-7.8	<2	Low----------	0.24	5	1-2
Yturria	8-65	8-19	2.0-6.0	0.10-0.15	6.6-8.4	<2	Low----------	0.24		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency*	Duration	Months	Depth**	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
An***. Arents											
Ar---------- Arrada	D	Frequent----	Very long	Jan-Dec	+1-4.0	Apparent	Jan-Dec	>60	---	High-----	Moderate.
Ba---------- Barraqa	D	None--------	---	---	+1-3.0	Apparent	Jan-Dec	>60	---	High-----	Moderate.
Bg***, Bs***. Beaches											
Ca---------- Camargo	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
DeA, DfA, DfB----- Delfina	B	None--------	---	---	2.5-5.0	Apparent	Sep-May	>60	---	High-----	Low.
Dn***. Dune land											
FaB---------- Falfurrias	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
GaB---------- Galveston	A	Rare--------	---	---	3.0-6.0	Apparent	Jan-Dec	>60	---	High-----	Low.
GdB***: Galveston--------	A	Rare--------	---	---	3.0-6.0	Apparent	Jan-Dec	>60	---	High-----	Low.
Dune land.											
GmB***: Galveston--------	A	Rare--------	---	---	3.0-6.0	Apparent	Jan-Dec	>60	---	High-----	Low.
Mustang----------	A/D	Occasional	Brief to long.	Aug-Nov	0-0.5	Apparent	Jan-Dec	>60	---	High-----	Low.
HaA, HaB---------- Hargill	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
HgB, HoA---------- Hidalgo	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Ic---------- Incell	D	None--------	---	---	+3-1.0	Artesian	Jan-Dec	>60	---	High-----	Low.
Ja---------- Jarron	D	None--------	---	---	+1-2.0	Apparent	Sep-May	>60	---	High-----	Low.
LaB---------- Lalinda	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Le---------- Latina	D	Occasional	Long------	Sep-May	1.0-3.0	Apparent	Sep-May	>60	---	High-----	Low.
Lm---------- Lomalta	D	None--------	---	---	+1-6.0	Apparent	Sep-May	>60	---	High-----	Moderate.
Ln---------- Lozano	B	None--------	---	---	1.0-3.0	Apparent	Sep-May	>60	---	High-----	Low.

See footnotes at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency*	Duration	Months	Depth**	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
Ly---- Lyford	C	None----	---	---	3.0-5.0	Apparent	Sep-May	>60	---	High----	Low.
Me---- Mercedes	D	None----	---	---	>6.0	---	---	>60	---	High----	Low.
Mp---- Mercedes	D	Occasional	Long----	Sep-May	+1-1.0	Perched	Sep-May	>60	---	High----	Low.
Mu---- Mustang	A/D	Occasional	Brief to long.	Aug-Nov	0-0.5	Apparent	Jan-Dec	>60	---	High----	Low.
Nu---- Nueces	C	None----	---	---	>6.0	---	---	>60	---	Moderate	Low.
Po---- Porfirio	C	Occasional	Brief----	Sep-Oct	2.0-4.0	Apparent	Sep-Oct	>60	---	High----	Moderate.
Ra---- Racombes	B	Rare----	---	---	>6.0	---	---	>60	---	High----	Low.
Rc---- Racombes	B	Rare----	---	---	1.5-4.5	Apparent	Sep-May	>60	---	High----	Low.
Rd---- Raymondville	D	None----	---	---	>6.0	---	---	>60	---	High----	Low.
Re---- Raymondville	D	None----	---	---	2.5-4.5	Apparent	Sep-May	>60	---	High----	Low.
Rf, Rg---- Rio	D	None----	---	---	+1-6.0	Apparent	Mar-Jun	>60	---	High----	Low.
Rs---- Rio	D	None----	---	---	+2-4.5	Apparent	Sep-May	>60	---	High----	Low.
SaB---- Sarita	A	None----	---	---	>6.0	---	---	>60	---	Low----	Low.
Sf---- Satatton	D	Frequent----	Very brief	Aug-May	1.0-3.0	Apparent	Jan-Dec	>60	---	High----	High.
SgB***: Satatton----	D	Frequent----	Very brief	Aug-May	1.0-3.0	Apparent	Jan-Dec	>60	---	High----	High.
Galveston----	A	Rare----	---	---	3.0-6.0	Apparent	Jan-Dec	>60	---	High----	Low.
Ss---- Saucel	D	Occasional	Brief----	Jul-Sep	0.5-2.0	Apparent	Jan-Dec	>60	---	High----	High.
Su, Sz---- Sauz	B	None----	---	---	1.0-3.0	Apparent	Sep-May	>60	---	High----	Moderate.
Ta---- Tatton	D	None----	---	---	+1-0.5	Apparent	Jan-Dec	>60	---	High----	High.
Tc---- Tiocano	D	Frequent----	Long----	Sep-May	+1-6.0	Perched	Sep-May	>60	---	High----	Low.
UdB***. Udipsamments											
Uf***, Us***. Ustorthents											
WaA, WaB---- Willacy	B	None----	---	---	>6.0	---	---	>60	---	Moderate	Low.

See footnotes at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency*	Duration	Months	Depth**	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
Wf---------- Willamar	B	None--------	---	---	3.0-6.0	Apparent	Sep-May	>60	---	High-----	Moderate.
Ws---------- Willamar	B	None--------	---	---	+1-3.0	Apparent	Sep-May	>60	---	High-----	Moderate.
Yf---------- Yturria	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.

* Highways, farm roads, railways, and other manmade structures may restrict surface drainage and thereby cause local flooding of large areas of soils that ordinarily are not subject to flooding.

** A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

*** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX TEST DATA

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution[1]									Liquid limit[2]	Plasticity index[2]	Specific gravity	Shrinkage		
			Percentage passing sieve--						Percentage smaller than--						Limit	Linear	Ratio
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm						
												Pct		G/cm^3	Pct	Pct	Pct
Arrada sandy clay loam:[3] (S78TX-489-003)																	
ACsa-----5 to 16	A-2-4(00)	SM-SC	100	99	98	97	96	28	23	15	15	24	7	2.72	18.0	3.3	1.7
C2sa----32 to 58	A-6 (03)	SC	100	99	99	98	98	37	34	28	27	35	20	2.68	19.0	7.7	1.7
C3gsa---54 to 80	A-2-6(00)	SC	100	100	100	100	100	24	23	18	18	28	11	2.67	21.0	3.9	1.6
Delfina fine sandy loam:[4] (S78TX-489-001)																	
A1-------7 to 16	A-2-4(00)	SM	100	100	100	100	100	25	22	11	11	19	3	2.60	17.0	1.6	1.7
B22t----23 to 32	A-6 (03)	SC	100	100	100	100	100	40	35	27	26	33	18	2.67	18.0	7.7	1.7
B24t----39 to 58	A-6 (03)	SC	100	100	100	100	100	39	35	25	24	33	19	2.66	18.0	7.5	1.7
B31tca--58 to 72	A-6 (02)	SC	100	100	100	100	100	39	33	24	23	31	16	2.66	18.0	7.0	1.7
B32tca--72 to 96	A-6 (03)	SC	100	100	100	100	99	42	35	26	24	32	18	2.69	17.0	7.5	1.7
Nueces fine sand:[5] (S77TX-489-002)																	
A11------0 to 22	A-2-4(00)	SP-SM	100	100	100	100	100	9	7	2	2	22	2	2.63	17.0	0.3	1.7
B22t----32 to 39	A-2-6(00)	SC	100	100	100	100	100	26	25	20	20	30	14	2.63	20.0	5.1	1.6
B3ca----58 to 76	A-2-4(00)	SC	100	100	100	100	100	23	21	18	15	28	9	2.66	21.0	3.7	1.6
Sauz loamy fine sand:[6] (S78TX-489-002)																	
A1-------0 to 7	A-2-4(00)	SM	100	100	100	100	100	13	10	4	3	20	2	2.63	18.0	1.0	1.6
B22t----13 to 24	A-2-4(00)	SC	100	100	99	99	99	27	25	17	16	27	10	2.63	20.0	3.6	1.6

See footnotes at end of table.

TABLE 16.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution[1]									Liquid limit[2]	Plasticity index[2]	Specific gravity	Shrinkage		
			Percentage passing sieve--						Percentage smaller than--						Limit	Linear	Ratio
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm						
												Pct		G/cm^3	Pct	Pct	Pct
Willamar fine sandy loam:[7] (S78TX-489-005)																	
B22t-----9 to 15	A-6 (03)	SC	100	100	100	100	100	41	38	28	25	31	17	2.65	18.0	6.6	1.7
C1casa--28 to 44	A-6 (07)	CL	100	100	99	98	98	51	48	37	29	34	23	2.69	16.0	9.3	1.8

[1]For soil materials larger than 3/8 inch, square mesh wire sieves that are slightly larger than equivalent round sieves were used, but this difference in procedure does not seriously affect the data.

[2]Liquid limit and plasticity index values were determined by the AASHTO-89 and AASHTO-90 methods except that soil was added to water.

[3]Arrada sandy clay loam: From north end of Farm Road 606, 0.5 mile W. and 100 feet S. of fence.

[4]Delfina fine sandy loam: From Farm Road 490, 0.7 mile S. on Farm Road 1015, 0.7 mile W. on county road, 300 feet S. and 100 feet E. in citrus orchard. This pedon is not typical for the series.

[5]Nueces fine sand: From U.S. Highway 77 and north county line, 1.5 miles W. in pasture.

[6]Sauz loamy fine sand: From entrance to Port Mansfield, 0.1 mile S. and 100 feet W. in pasture.

[7]Willamar fine sandy loam: From Farm Road 1420, 4.6 miles E. on south levee road, 0.1 mile S. in pasture.

TABLE 17.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Arrada	Fine-loamy, mixed, hyperthermic Typic Salorthids
Barrada	Fine, mixed, hyperthermic Aquollic Salorthids
Camargo	Fine-silty, mixed (calcareous), hyperthermic Typic Ustifluvents
Delfina	Fine-loamy, mixed, hyperthermic Aquic Paleustalfs
Falfurrias	Mixed, hyperthermic Typic Ustipsamments
Galveston	Mixed, hyperthermic Typic Udipsamments
Hargill	Fine-loamy, mixed, hyperthermic Udic Paleustolls
Hidalgo	Fine-loamy, mixed, hyperthermic Typic Calciustolls
Incell	Fine-loamy, mixed, hyperthermic Cumulic Haplaquolls
Jarron	Fine, mixed, hyperthermic Typic Natraqualfs
Lalinda	Fine-loamy, mixed, hyperthermic Ustollic Camborthids
Latina	Fine-loamy, mixed, hyperthermic Aquollic Salorthids
Lomalta	Very-fine, montmorillonitic, hyperthermic Udorthentic Pellusterts
Lozano	Fine-loamy, mixed, hyperthermic Aquic Haplustalfs
Lyford	Fine-loamy, mixed, hyperthermic Aquic Haplustalfs
Mercedes	Fine, montmorillonitic, hyperthermic Udorthentic Pellusterts
Mustang	Mixed, hyperthermic Typic Psammaquents
Nueces	Loamy, mixed, hyperthermic Aquic Arenic Paleustalfs
Porfirio	Fine, mixed, hyperthermic Aquic Calciustolls
Racombes	Fine-loamy, mixed, hyperthermic Pachic Argiustolls
Raymondville	Fine, mixed, hyperthermic Vertic Calciustolls
Rio	Fine, mixed, hyperthermic Typic Argiaquolls
Sarita	Loamy, mixed, hyperthermic Grossarenic Paleustalfs
Satatton	Sandy, mixed, hyperthermic Typic Salorthids
Saucel	Coarse-loamy, mixed, hyperthermic Typic Salorthids
Sauz	Coarse-loamy, mixed, hyperthermic Typic Natraqualfs
Tatton	Siliceous, hyperthermic Typic Psammaquents
Tiocano	Fine, montmorillonitic, hyperthermic Udic Pellusterts
Willacy	Fine-loamy, mixed, hyperthermic Udic Argiustolls
Willamar	Fine-loamy, mixed, hyperthermic Typic Natraqualfs
Yturria	Coarse-loamy, mixed, hyperthermic Pachic Haplustolls

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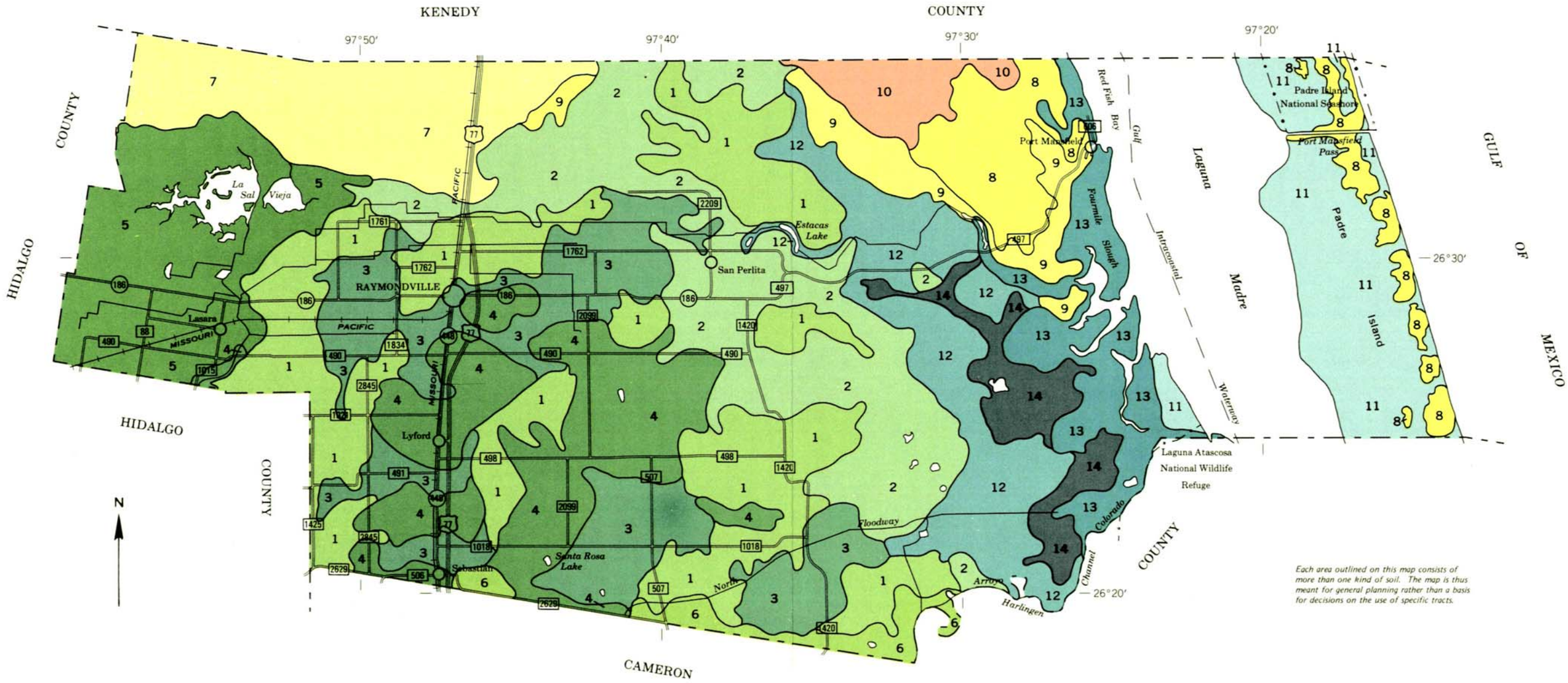


Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

LEGEND*

LOAMY AND CLAYEY SOILS DOMINANTLY OF THE MIDDLE AND HIGH STREAM TERRACES

1 Raymondville-Mercedes: Nearly level, moderately alkaline, nonsaline loamy and clayey soils

2 Lyford-Lozano: Nearly level, neutral, nonsaline loamy soils

3 Hidalgo-Racombes: Nearly level to gently sloping, neutral to moderately alkaline, nonsaline loamy soils

4 Willacy-Racombes: Nearly level to gently sloping, neutral and mildly alkaline, nonsaline loamy soils

5 Delfina-Hargill-Willacy: Nearly level to gently sloping, neutral to moderately alkaline, nonsaline loamy soils

6 Willacy-Raymondville: Nearly level to gently sloping, neutral to moderately alkaline, nonsaline loamy soils

SANDY SOILS OF THE EOLIAN SAND SHEET AND BARRIER ISLAND

7 Nueces-Sarita: Nearly level to gently undulating, neutral, nonsaline sandy soils

8 Galveston-Mustang-Dune land: Nearly level to gently undulating, moderately alkaline, nonsaline sandy soils and undulating to rolling Dune land

9 Sauz: Nearly level, mildly alkaline to strongly alkaline, saline sandy soils

10 Falfurrias: Gently undulating, neutral and mildly alkaline, nonsaline sandy soils

LOAMY AND CLAYEY SOILS OF THE LOW COASTAL TERRACE AND BARRIER ISLAND

11 Satatton-Tatton: Nearly level, moderately alkaline and strongly alkaline, saline sandy soils

12 Willamar-Porfirio: Nearly level, neutral to moderately alkaline, saline loamy soils

13 Barrada-Lalinda-Arrada: Nearly level to gently sloping, mildly alkaline to strongly alkaline, saline and nonsaline clayey and loamy soils

14 Saucel-Latina: Nearly level, moderately alkaline and strongly alkaline, saline loamy soils

*The terms for texture refer to the surface layer of the major soils. The terms for reaction and salinity refer to the upper part of the soil.

Compiled 1981

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

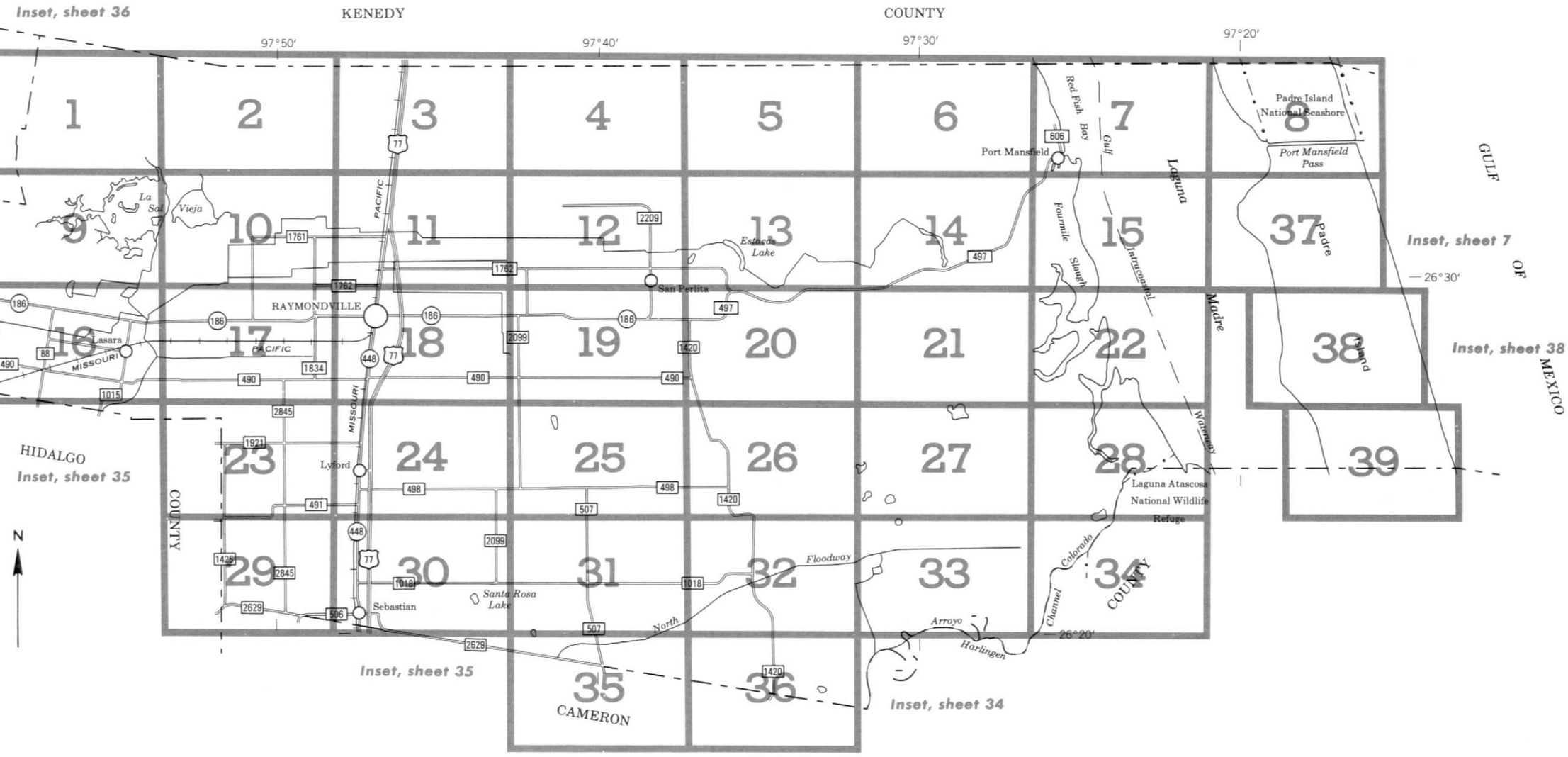
GENERAL SOIL MAP

WILLACY COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km



Original text from each individual map sheet read:

This map is compiled on 1977 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

INDEX TO MAP SHEETS

WILLACY COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Oil wasteland < 3 acres in size

SOIL LEGEND

The first letter of the symbol, always a capital, is the initial letter of the soil name. The second letter is a small letter. The third letter, if used, is a capital letter and connotes slope class. Symbols without a slope letter are for level soils or miscellaneous areas.

SYMBOL	NAME
An	Arents, loamy
Ar	Arrada sandy clay loam
Ba	Barrada clay
Bg	Beaches, gravelly
Bs	Beaches, sandy
Ca	Camargo silty clay loam
DeA	Delfina loamy fine sand, 0 to 2 percent slopes
DfA	Delfina fine sandy loam, 0 to 1 percent slopes
DfB	Delfina fine sandy loam, 1 to 3 percent slopes
Dn	Dune land
FaB	Falfurrias fine sand, gently undulating
GaB	Galveston fine sand, gently undulating
GdB	Galveston-Dune land complex, gently undulating
GmB	Galveston-Mustang complex, gently undulating
HaA	Hargill fine sandy loam, 0 to 1 percent slopes
HaB	Hargill fine sandy loam, 1 to 3 percent slopes
HgB	Hidalgo fine sandy loam, 1 to 3 percent slopes
HoA	Hidalgo sandy clay loam, 0 to 1 percent slopes
Ic	Incell clay
Ja	Jarron sandy clay loam
LaB	Lalinda sandy clay loam, 1 to 5 percent slopes
Le	Latina sandy clay loam
Lm	Lomalta clay
Ln	Lozano fine sandy loam
Ly	Lyford sandy clay loam
Me	Mercedes clay
Mp	Mercedes clay, ponded
Mu	Mustang fine sand
Nu	Nueces fine sand
Po	Porfirio sandy clay loam
Ra	Racombes sandy clay loam
Rc	Racombes sandy clay loam, saline
Rd	Raymondville clay loam
Re	Raymondville clay loam, saline
Rf	Rio fine sandy loam
Rg	Rio sandy clay loam
Rs	Rio sandy clay loam, saline
SaB	Sarita fine sand, gently undulating
Sf	Satatton fine sand
SgB	Satatton-Galveston complex, gently undulating
Ss	Saucel sandy loam
Su	Sauz fine sand
Sz	Sauz loamy fine sand
Ta	Tatton fine sand
Tc	Tiocano clay
UdB	Udipsamments, gently undulating
Uf	Ustorthents, loamy
Us	Ustorthents, clayey
WaA	Willacy fine sandy loam, 0 to 1 percent slopes
WaB	Willacy fine sandy loam, 1 to 3 percent slopes
Wf	Willamar fine sandy loam
Ws	Willamar fine sandy loam, strongly saline
Yf	Yturria fine sandy loam

WILLACY COUNTY, TEXAS — SHEET NUMBER 1

2 170 000 FEET

(Joins inset, sheet 36)

335 000 FEET

COUNTY

HIDALGO

DeA Nu Rg Ic Su Tc Rf SaB Yf WaB WaA DfA Ra HgB Ly Ws water

(Joins sheet 9)

2 195 000 FEET

N

2 Miles

10000 Feet

(Joins sheet 2)

325 000 FEET

Scale 1:24000

WILLACY COUNTY, TEXAS — SHEET NUMBER 2

2

N

2 225 000 FEET

340 000 FEET

KENEDY COUNTY

APPROXIMATE BOUNDARY

Nu Su Rg Rf Ic Yf SaB Ja Tc WaB WaA DeA HaB HgB DfA Ly

2 Miles

10000 Feet

5000

0

1000

2000

3000

4000

5000

Scale 1:24000

(Joins sheet 1)

(Joins sheet 3)

320 000 FEET

2 200 000 FEET

(Joins sheet 10)

WILLACY COUNTY, TEXAS — SHEET NUMBER 3

3

2 230 000 FEET

335 000 FEET

KENEDY COUNTY BOUNDARY

APPROXIMATE Airstrip

PACIFIC

MISSOURI

Yturria

Airstrip

Airstrip

77

SaB Rf Nu Ja Yf Su DeA Ic Ln Rg Wf WaA Ly Me Rd Tc

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 11)

2 255 000 FEET

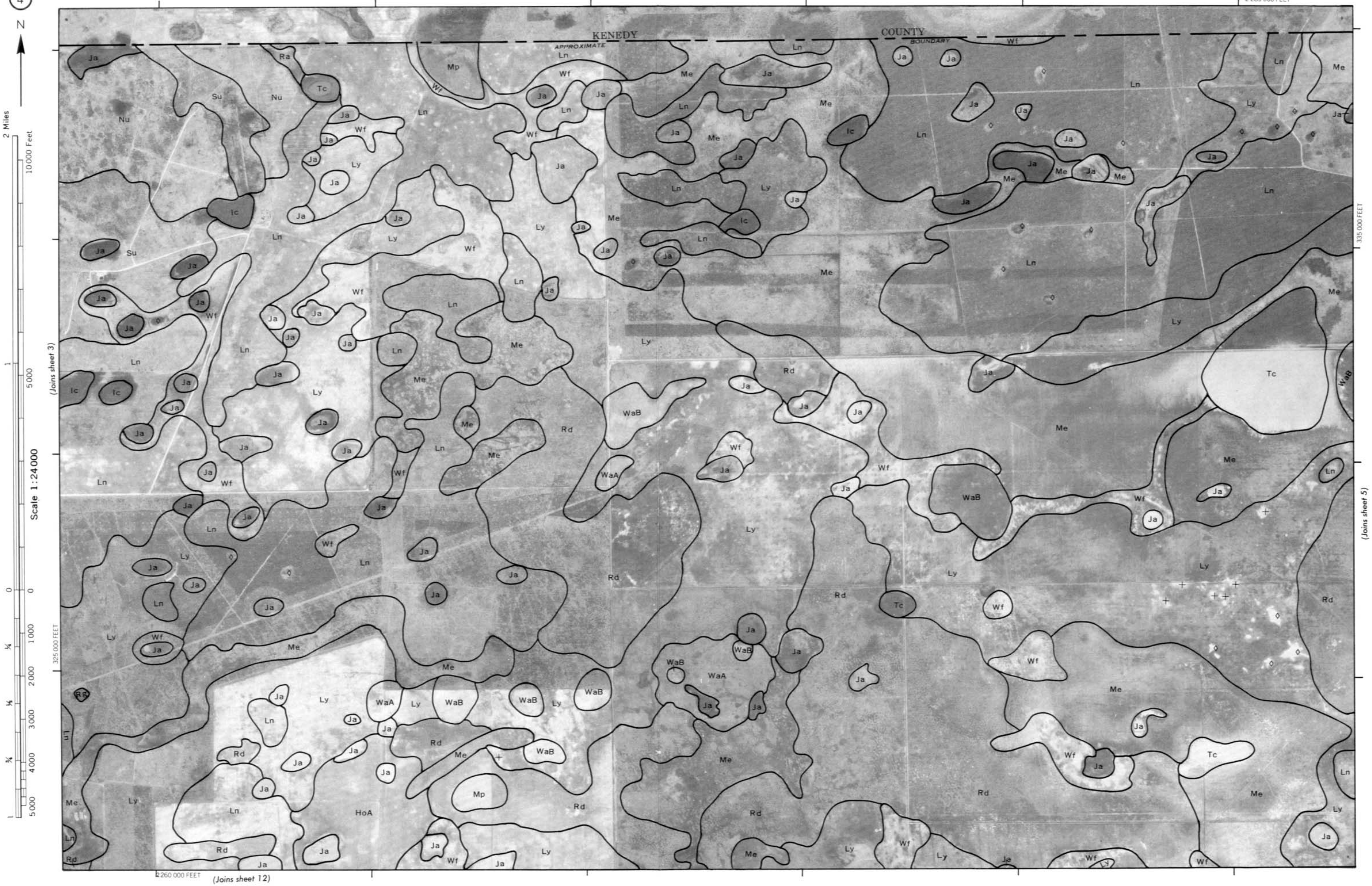
N

2 Miles

10000 Feet

Scale 1:24000

325 000 FEET


N
2 Miles
10000 Feet
5000
0
1000
2000
3000
4000
5000
Scale 1:24 000
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 12)
KENEDY COUNTY
APPROXIMATE BOUNDARY
2 285 000 FEET
335 000 FEET
325 000 FEET
2 260 000 FEET

WILLACY COUNTY, TEXAS — SHEET NUMBER 5

2 290 000 FEET

340 000 FEET

KENEDY APPROXIMATE BOUNDARY COUNTY

(Joins sheet 4)

(Joins sheet 13)

2 315 000 FEET

325 000 FEET

(Joins sheet 6)

5

N

2 Miles

10000 Feet

Scale 1:24000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

WILLACY COUNTY, TEXAS — SHEET NUMBER 6

6

N

2 345 000 FEET

340 000 FEET

KENNEDY COUNTY APPROXIMATE BOUNDARY

Scale 1:24 000

2 Miles 1 0 1

10 000 Feet 5 000 0 5 000

¼ ½ ¾ ¼ ½ ¾

1000 2000 3000 4000

325 000 FEET

2 320 000 FEET

(Joins sheet 5)

(Joins sheet 7)

(Joins sheet 14)

Air Strip

2 350 000 FEET
340 000 FEET
KENNEDY COUNTY
APPROXIMATE BOUNDARY
2 406 000 FEET (Joins sheet 8)
315 000 FEET
GULF OF MEXICO
RED FISH BAY
LAGUNA MADRE
PADRE ISLAND
Port Mansfield
water
Air Strip
(Joins sheet 37)
(Joins sheet 6)
(Joins sheet 38)
2 410 000 FEET
305 000 FEET
325 000 FEET
2 375 000 FEET
(Joins sheet 15)
4000 AND 5000-FOOT GRID TICKS
Ar
Ba
Sz
LaB
Bg
Ss
Ta
Bs
SgB
Sf
Mu
GdB
Dn
Us
GaB
606
N
2 Miles
10000 Feet
5000
Scale 1:24000

(8)

N

2 405 000 FEET

340 000 FEET

KENNEDY COUNTY
APPROXIMATE BOUNDARY

PADRE ISLAND

GULF OF MEXICO

LAGUNA MADRE

Port Mansfield Cut

Ta
Sf
Dn
SgB
GdB
Bs
Mu
Us
UdB

(Joins sheet 7)

(Joins sheet 37)

2 380 000 FEET

325 000 FEET

2 Miles
10000 Feet
Scale 1:24000
5000
0
1000
2000
3000
4000
5000

WILLACY COUNTY, TEXAS — SHEET NUMBER 9

9

2 170 000 FEET

(Joins sheet 1)

315 000 FEET

HIDALGO COUNTY

La Sal Vieja

water

Reservoir

Reservoir

(Joins sheet 10)

(Joins inset, Joins sheet 23)

HaA

305 000 FEET

2 195 000 FEET

(Joins sheet 16)

N

2 Miles

10000 Feet

Scale 1:24000

10

N

Scale 1:24000

2 Miles 1 0 1

10000 Feet 5000 0 1000 2000 3000 4000 5000

(Joins sheet 2)

2 225 000 FEET

320 000 FEET

305 000 FEET

2 200 000 FEET

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 17)

La Sal Vieja

water

DRAIN WEST

DRAIN MAIN

1761

1762

WILLACY COUNTY, TEXAS — SHEET NUMBER 11

11

2 230 000 FEET

320 000 FEET

(Joins sheet 3)

(Joins sheet 10)

(Joins sheet 12)

(Joins sheet 18)

2 255 000 FEET

305 000 FEET

N

2 Miles

10000 Feet

1

5000

0

Scale 1:24000

0 1000 2000 3000 4000 5000

PACIFIC

MISSOURI

WEST

MAIN

DRAIN

CITY DUMP

Reservoir

Air Strip

1761

1762

448

77

Tc Su Nu Rf DeA Rg Ja Ly Yf Ln Rd Mp Ra Me Rs Wf WaA WaB HoA An HaB

(12)

N

(Joins sheet 4)

2 285 000 FEET

320 000 FEET

2 Miles

10 000 Feet

Scale 1:24 000

(Joins sheet 11)

305 000 FEET

2 260 000 FEET

(Joins sheet 19)

(Joins sheet 13)

EAST MAIN DRAIN

San Perlita

2209

1762

3142

WILLACY COUNTY, TEXAS — SHEET NUMBER 13

13

2 290 000 FEET

320 000 FEET

(Joins sheet 5)

(Joins sheet 12)

(Joins sheet 14)

(Joins sheet 20)

2 315 000 FEET

305 000 FEET

N

2 Miles

10000 Feet

1

Scale 1:24000

5000

0

1000

2000

3000

4000

5000

EAST

MAIN

DRAIN

3142

497

(14)

N

(Joins sheet 6)

2 345 000 FEET

320 000 FEET

(Joins sheet 13)

(Joins sheet 15)

305 000 FEET

2 320 000 FEET

(Joins sheet 21)

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 1000 2000 3000 4000 5000

MAIN DRAIN

EAST DRAIN

water

497

(Joins sheet 7)

15

2 350 000 FEET

320 000 FEET

LAGUNA MADRE

Island

Sauz

Fourmile Slough

497

(Joins sheet 14)

(Joins sheet 37)

(Joins sheet 22)

2 375 000 FEET

305 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000

N

Scale 1:24000

2 Miles 10000 Feet

1 5000 0 1000 2000 3000 4000 5000

(Joins sheet 9)

(Joins inset, sheet 29)

(Joins sheet 17)

(Joins inset, sheet 35)

2 195 000 FEET

300 000 FEET

285 000 FEET

2 170 000 FEET

HIDALGO COUNTY

MISSOURI PACIFIC

WEST MAIN DRAIN

MAIN CANAL

LATERAL

NORTHEAST BRANCH

MAIN DRAIN

Lasara

WILLACY COUNTY, TEXAS — SHEET NUMBER 17

17

2 200 000 FEET

300 000 FEET

(Joins sheet 10)

(Joins sheet 16)

(Joins sheet 18)

(Joins sheet 23)

2 225 000 FEET

285 000 FEET

N

Scale 1:24 000

2 Miles

10 000 Feet

5000

MAIN DRAIN WEST

MISSOURI PACIFIC NORTHEAST MAIN BRANCH CANAL

1761 1425 1834 2845 490 186

Rg Rd HoA WaA Ra WaB Rc Tc Re Me Uf Ly Rs DfA

18

N

Scale 1:24000

2 Miles 10000 Feet

1 5000 0 1000 2000 3000 4000 5000

(Joins sheet 11)

(Joins sheet 17)

(Joins sheet 19)

(Joins sheet 24)

2 255 000 FEET

300 000 FEET

285 000 FEET

2 230 000 FEET

RAYMONDVILLE
(county seat)

Fox Airport

Air Strip

Air Strip

Air Strip

MORRIS PIT

SEWAGE DISPOSAL

PACIFIC

MISSOURI

water

WILLACY COUNTY, TEXAS — SHEET NUMBER 19

19

2 260 000 FEET

300 000 FEET

(Joins sheet 12)

(Joins sheet 18)

(Joins sheet 20)

(Joins sheet 25)

2 285 000 FEET

N

2 Miles

10000 Feet

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

WILLACY COUNTY, TEXAS — SHEET NUMBER 20

20

N

(Joins sheet 13)

2 315 000 FEET

300 000 FEET

(Joins sheet 19)

285 000 FEET

2 290 000 FEET

(Joins sheet 26)

(Joins sheet 21)

Willamar

HoA

Scale 1:24000

2 Miles 1 0 1

10000 Feet 5000 0 1000 2000 3000 4000 5000

WILLACY COUNTY, TEXAS — SHEET NUMBER 21

2 320 000 FEET

300 000 FEET

(Joins sheet 14)

(Joins sheet 20)

(Joins sheet 22)

(Joins sheet 27)

285 000 FEET

2 345 000 FEET

21

N

2 Miles 1 0 10000 Feet

Scale 1:24000

1 ¾ ½ ¼ 0 1000 2000 3000 4000 5000

22

N

(Joins sheet 15)

2 375 000 FEET

300 000 FEET

LAGUNA MADRE

Green Hill Island

Chubby Island

Mullet Island

Josephine Island

water

Ar Ba Bg Le LaB Ln Ss Sz Us Sf

(Joins sheet 21)

285 000 FEET

2 350 000 FEET

(Joins sheet 28)

2 Miles 10 000 Feet

Scale 1:24000

1 5000 0 1000 2000 3000 4000 5000

(Joins inset A, sheet 35)

2 200 000 FEET

280 000 FEET

(Joins sheet 17)

23

N

2 165 000 FEET

315 000 FEET

COUNTY

HIDALGO COUNTY

1425

1921

2845

491

186

(Joins sheet 9)

305 000 FEET

(Joins inset, sheet 29)

2 170 000 FEET

(Joins sheet 24)

265 000 FEET

(Joins sheet 29)

2 225 000 FEET

2 Miles

10000 Feet

Scale 1:24000

N

Scale 1:24000

2 Miles 10000 Feet

1 5000 0 0 1000 2000 3000 4000 5000

(Joins sheet 18)

(Joins sheet 23)

(Joins sheet 25)

(Joins sheet 30)

2 255 000 FEET

280 000 FEET

265 000 FEET

2 230 000 FEET

PACIFIC

MISSOURI

LYFORD

SEWAGE DISPOSAL

water

WILLACY COUNTY, TEXAS — SHEET NUMBER 25

2 260 000 FEET

280 000 FEET

(Joins sheet 19)

25

N

2 Miles

10000 Feet

(Joins sheet 26)

1

5000

Scale 1:24000

0

1000

2000

3000

4000

5000

265 000 FEET

(Joins sheet 24)

(Joins sheet 31)

2 285 000 FEET

WILLACY COUNTY, TEXAS — SHEET NUMBER 26

26

N

Scale 1:24000

2 Miles 1 0 1 2 3 4 5

10000 Feet 5000 0 1000 2000 3000 4000 5000

(Joins sheet 20)

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 32)

2 315 000 FEET

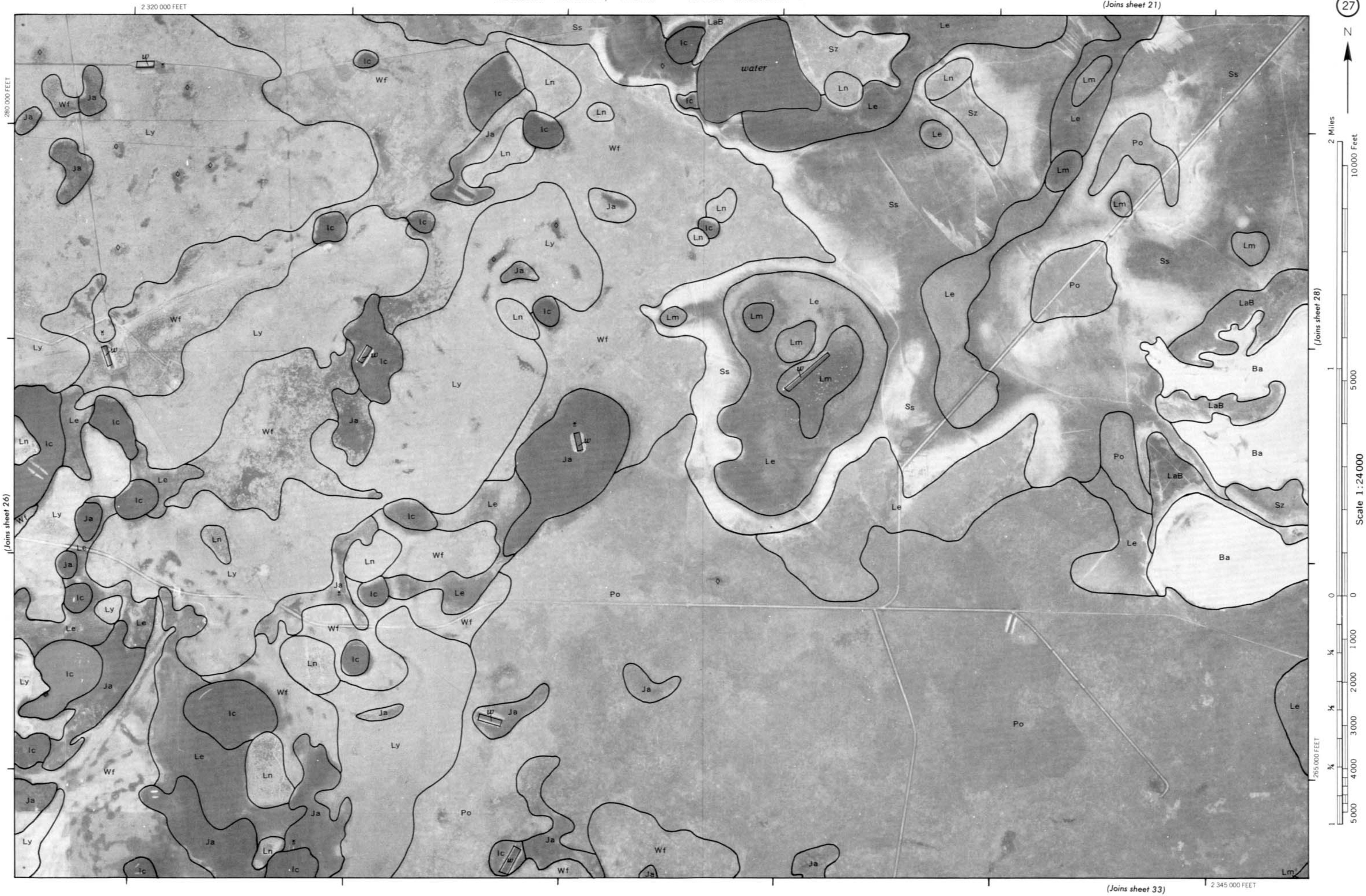
280 000 FEET

265 000 FEET

2 290 000 FEET

Porfirio

Willamar Camp


2 320 000 FEET
280 000 FEET
(Joins sheet 21)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 33)
265 000 FEET
2 345 000 FEET
N
2 Miles
10000 Feet
Scale 1:24000
water
Ss
LaB
Ic
Sz
Le
Ln
Lm
Wf
Ja
Ly
Po
Ba
w

WILLACY COUNTY, TEXAS — SHEET NUMBER 28

28

N

(Joins sheet 22)

2 375 000 FEET

280 000 FEET

(Joins sheet 27)

265 000 FEET

2 350 000 FEET

(Joins sheet 34)

Scale 1:24000

2 Miles 0 1

10000 Feet 0 1000 2000 3000 4000 5000

¼ ¼ ¼ ¼

LAGUNA MADRE

Hawk Island

Mud Island

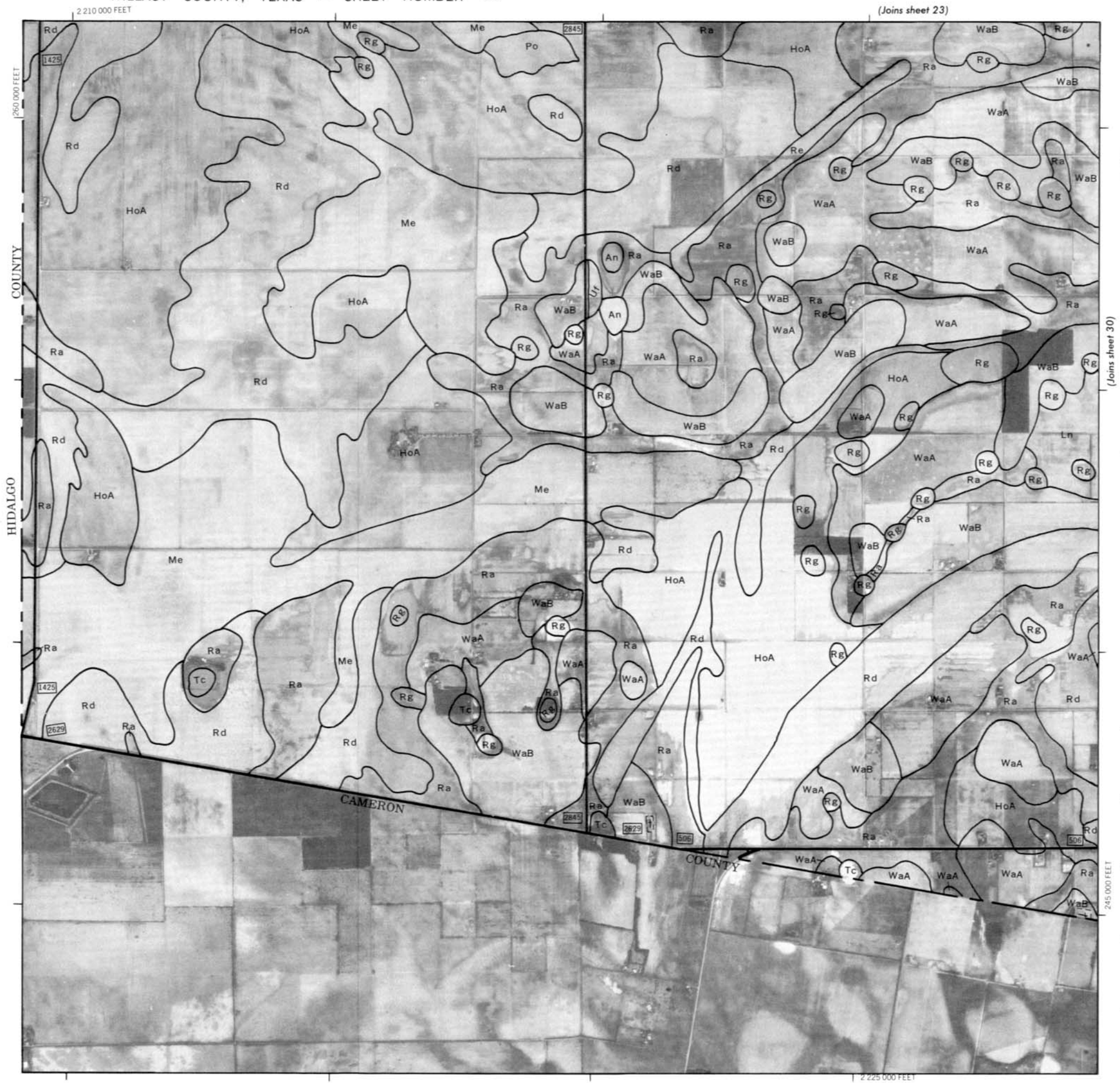
LAGUNA ATASCOSA NATIONAL WILDLIFE REFUGE

LAGUNA ATASCOSA NATIONAL WILDLIFE REFUGE

CAMERON COUNTY

water

LaB Ba Le Ss Sz Us Sf Po Ar Lm



29

N

2 Miles 1 0

10000 Feet 5000 0

Scale 1:24000

1 1/4 1/2 3/4 1

WILLACY COUNTY, TEXAS — SHEET NUMBER 30

30

N

(Joins sheet 24)

(Joins sheet 29)

(Joins sheet 31)

(Joins inset, sheet 35)

2 255 000 FEET

260 000 FEET

245 000 FEET

2 230 000 FEET

Scale 1:24000

2 Miles 1 0

10000 Feet 5000 0

1 5000 ¼ 4000 ½ 3000 ¾ 2000 1 1000 0

Santa Rosa Lake

Sebastian

PACIFIC

MISSOURI

CAMERON COUNTY

WILLACY COUNTY, TEXAS — SHEET NUMBER 31

2 260 000 FEET

260 000 FEET

(Joins sheet 25)

(Joins sheet 30)

(Joins sheet 32)

(Joins sheet 35)

245 000 FEET

2 285 000 FEET

507

1018

Los Coyotes

FLOODWAY CHANNEL

NORTH FLOODWAY PILOT

31

N

2 Miles

10000 Feet

Scale 1:24000

32

N

(Joins sheet 26)

2 315 000 FEET

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

(Joins sheet 31)

245 000 FEET

2 290 000 FEET

(Joins sheet 36)

(Joins sheet 33)

260 000 FEET

Santa Monica

North CHANNEL

PILOT

FLOODWAY

Floodway

North

Floodway

1420

1018

WILLACY COUNTY, TEXAS — SHEET NUMBER 33

33

2 320 000 FEET

260 000 FEET

(Joins sheet 27)

(Joins sheet 32)

(Joins inset A, sheet 34)

(Joins inset B, sheet 34)

(Joins sheet 34)

245 000 FEET

2 345 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000

North FLOODWAY PILOT CHANNEL Floodway

CAMERON COUNTY ARROYO

COLORADO COUNTY

34

N

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 0

1/4 1000

1/2 2000

3/4 3000

4000

5000

(Joins sheet 28)

2 360 000 FEET

260 000 FEET

(Joins sheet 33)

245 000 FEET

2 350 000 FEET

INSET A

(Joins sheet 33)

2 325 000 FEET

240 000 FEET

(Joins sheet 36)

230 000 FEET

2 320 000 FEET

INSET B

(Joins sheet 33)

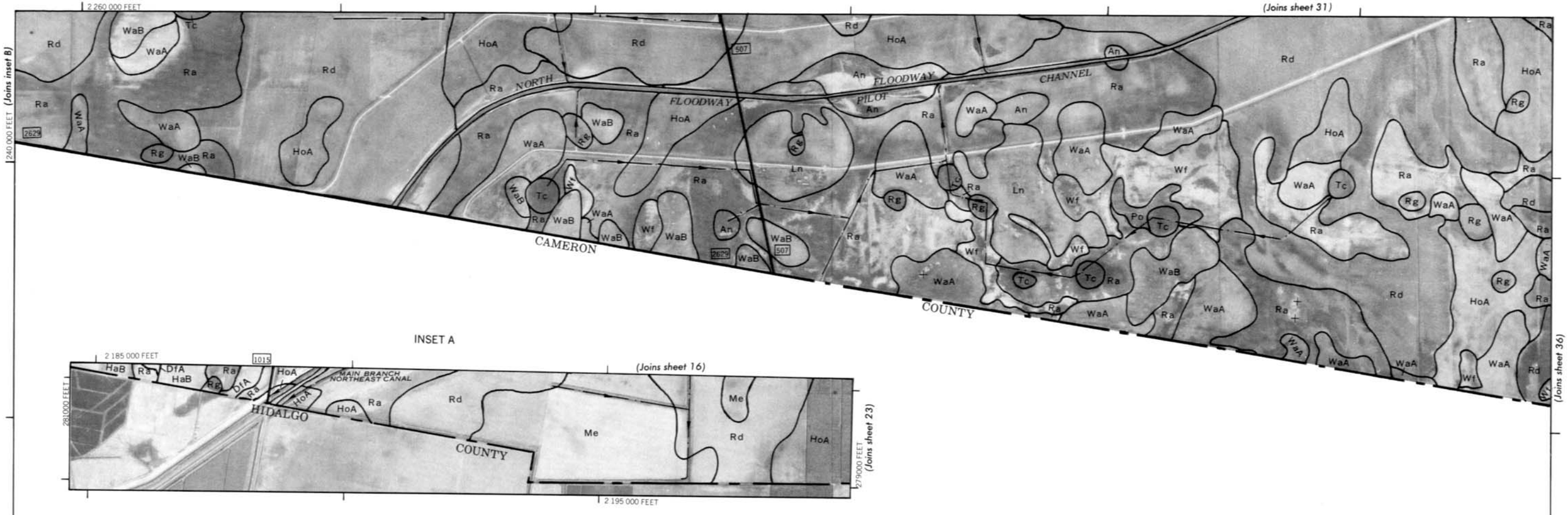
2 345 000 FEET

240 000 FEET

243 000 FEET

2 335 000 FEET

3000 AND 5000-FOOT GRID TICKS


2 260 000 FEET
(Joins sheet 31)
240 000 FEET (Joins inset B)
CAMERON
COUNTY
NORTH FLOODWAY
PILOT CHANNEL
FLOODWAY
2629
507
Rd
HoA
Ra
WaA
WaB
Tc
An
Rg
Ln
Wf
Po
INSET A
2 185 000 FEET
1015
(Joins sheet 16)
281000 FEET
279000 FEET (Joins sheet 23)
2 195 000 FEET
HIDALGO
COUNTY
MAIN BRANCH NORTHEAST CANAL
HaB
DfA
Me
2000 AND 5000-FOOT GRID TICKS
INSET B
2 245 000 FEET
(Joins sheet 30)
242 000 FEET
240 000 FEET (Joins upper left)
2 255 000 FEET
2000 AND 5000-FOOT GRID TICKS
2 285 000 FEET
225 000 FEET
N
2 Miles
10000 Feet
5000
Scale 1:24000
0
1000
2000
3000
4000
5000

(36)

N

2 Miles 10 000 Feet 1 5000

Scale 1:24 000

(Joins sheet 32)

(Joins sheet 35)

2 315 000 FEET

240 000 FEET

CAMERON COUNTY

KENEDY COUNTY

HIDALGO COUNTY

2 195 000 FEET

344 000 FEET

340 000 FEET

225 000 FEET

2 180 000 FEET

(Joins sheet 1)

(Joins inset, sheet 34)

2 290 000 FEET

4000 AND 5000-FOOT GRID TICKS

Ra Rg Wf Rd HoA WaA Tc Nu DeA SaB Su Ic Ly Ln Me Ca WaB HaB UdB

WILLACY COUNTY, TEXAS — SHEET NUMBER 37

37

2 380 000 FEET

320 000 FEET

(Joins sheet 8)

N

GULF OF MEXICO

PADRE ISLAND

Ta

Sf

Dn

SgB

GdB

Bs

Mu

(Joins inset, sheet 7)

305 000 FEET

2 405 000 FEET

(Joins sheet 38)

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

N

2 Miles

10000 Feet

5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

2 413 000 FEET

2 410 000 FEET

300 000 FEET

285 000 FEET

2 900 000 FEET

2 415 000 FEET

2 385 000 FEET

(Joins sheet 37)

(Joins inset, sheet 7)

(Joins lower right)

(Joins sheet 39)

(Joins inset)

2000 AND 5000-FOOT GRID TICKS

GULF OF MEXICO

water

Ta

Sf

Dn

Mu

GdB

Bs

SgB

(Joins sheet 38)

(Joins inset, sheet 38)

2 390 000 FEET

280 000 FEET

LAGUNA MADRE

Ta

Sf

GdB

Deer Island

Mu

Dn

SgB

Bs

GULF OF MEXICO

Us

CAMERON COUNTY

2 415 000 FEET

265 000 FEET

39

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 1000 2000 3000 4000 5000